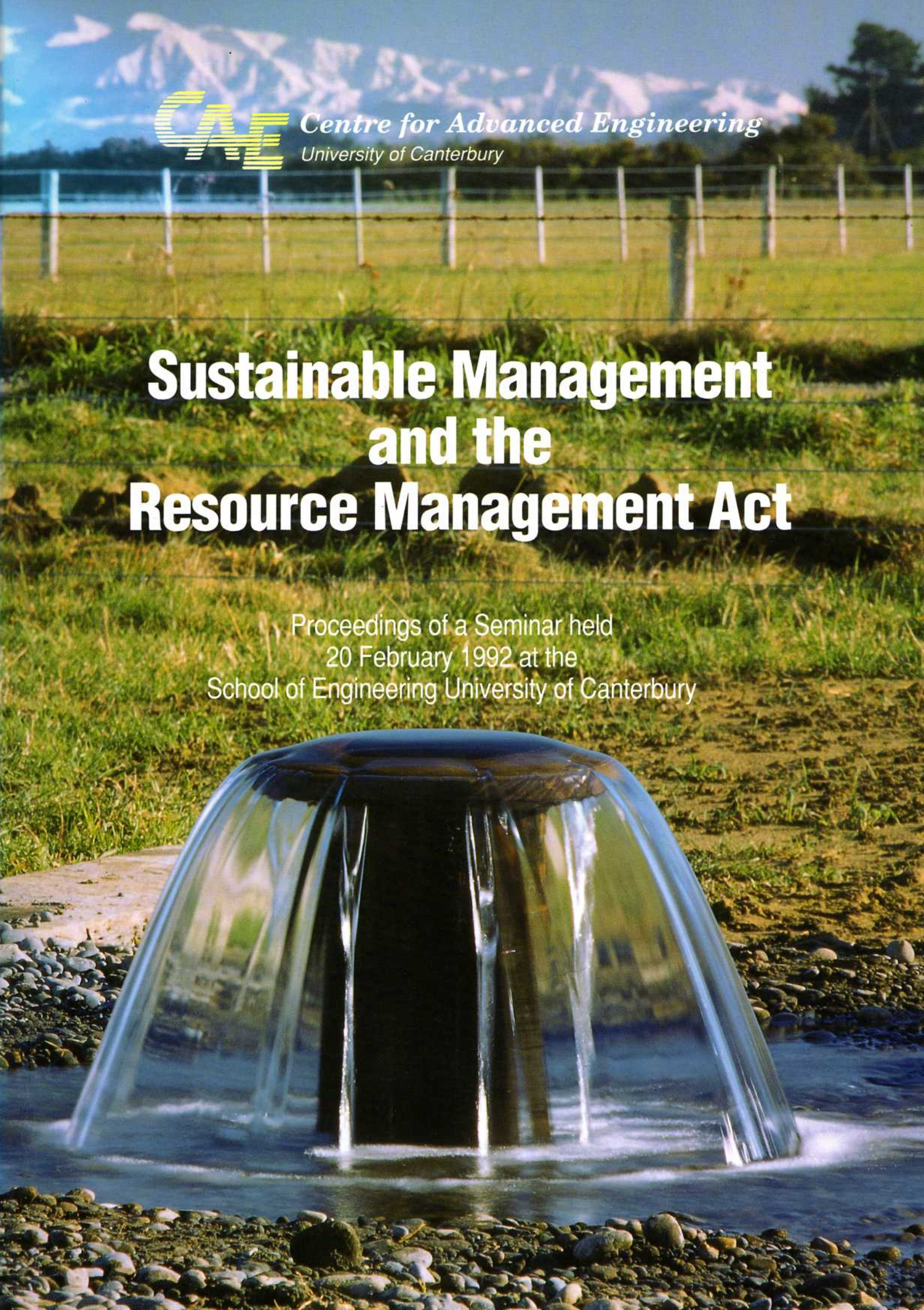

Centre for Advanced Engineering
University of Canterbury
Sustainable Management and the Resource Management Act
Proceedings of a Seminar held
20 February 1992 at the
School of Engineering University of Canterbury

Centre for Advanced Engineering

SUSTAINABLE MANAGEMENT

and the

RESOURCE MANAGEMENT ACT

Proceedings of a Seminar held 20 February 1992
at the School of Engineering
University of Canterbury

University of Canterbury

February 1993

About this pdf File

This pdf has been recreated (May 2011) from the original (1992) Word files – at that time, the printing process was photographic and graphics were taped onto printed pages. The graphics in this pdf have been scanned from a hard copy of the book and inserted electronically into the Word file.

ISBN 0-9598002-7-1

COVER PHOTOGRAPH

Utilising a resource already under pressure - a North Canterbury water bore being brought into production. The management of groundwater is one of the topics relating to sustainable management and the Resource Management Act which is covered in this book. Photo by Euan Sarginson.

PRINTING

The Printery, University of Canterbury

NOTE AND DISCLAIMER

The papers published in this volume are, for the most part, transcripts of recordings made during the Seminar at which they were presented. All of the transcript papers have been edited to ensure readability and have, in some cases, been modified by the inclusion of additional material (such as figures, tables and references) supplied by the speakers. Some portions of the recordings made (those that were irrelevant or indistinct) have not been transcribed.

While every effort has been made to ensure the accuracy of the transcripts contained in this volume, readers are reminded that they do appear as transcripts of spoken presentations or as papers incorporating transcribed material. Due care and acknowledgement should therefore be taken in referring to or quoting from these papers. Opinions expressed are those of the Seminar speakers and do not necessarily reflect the views of the Centre for Advanced Engineering.

Centre for Advanced Engineering

Establishment

The Centre for Advanced Engineering was founded in May 1987 to mark the centenary of the School of Engineering at the University of Canterbury. It was established by means of an appeal fund launched in conjunction with the centennial celebrations. To date approximately $2.3 million has been raised, contributed by 150 corporate donors and 650 individual donors. The earnings from this capital sum are used to run the Centre and fund its activities.

Objective

The objective of the Centre is to enhance engineering knowledge within New Zealand in identified areas judged to be of national importance and to engage in technology transfer of the latest research information available from overseas. The Centre is not concerned with basic engineering research, but with the application of research findings to engineering problems.

The objective is achieved for each major project undertaken by bringing together a selected group of practising and research engineers and experts in the particular field from both New Zealand and overseas to:

- consolidate existing knowledge
- study advanced techniques
- develop approaches to particular problems in engineering and technology
- promote excellence in engineering
- disseminate findings through documentation and public seminars

A unique forum for co-operation among industry, the engineering profession and university research engineers is thus provided.

Function

The Centre is controlled by a Board of Directors comprising representatives from industry, the engineering profession and the University of Canterbury. Chairman of the Board is Mr Peter Menzies of Auckland.

The Board selects the title for each project undertaken by the Centre and approves the level of funding. A Steering Committee is then appointed, initially to carry out detailed planning for the project and then to provide overall direction. The Steering Committee appoints Task Group Leaders and a Project Manager.

Detailed work on the project is carried out on a voluntary basis by the members appointed to each Task Group. The Centre arranges to bring to New Zealand, at the appropriate time, several Visiting Fellows to work with members of the Task Groups, bringing into the project the latest available information from overseas.

The Centre also undertakes smaller projects, such as the one described in this report, on engineering subjects of current concern, and arranges lectures and seminars on appropriate topics as the occasion arises.

Contact

Centre for Advanced Engineering
University of Canterbury
Private Bag 4800
Christchurch, New Zealand

STREET ADDRESS:
39 Creyke Road
Christchurch 4

Telephone: (03) 364 2478
Facsimile: (03) 364 2069

Executive Director: John P Blakeley
Projects Director: John L Lumsden

CONTENTS

FOREWORD

The idea to hold this seminar developed from a meeting held in Christchurch on 25 July 1991. Representatives of the IPENZ Standing Committee on Engineering and Environment visited Christchurch with the objective of establishing a "Sustainability Group" based in Christchurch.

As a first step in this process, the Centre for Advanced Engineering at the University of Canterbury (CAE) offered to arrange a one-day seminar to be held in conjunction with the IPENZ Annual Conference in Christchurch in February 1992. The suggested topic for this seminar was "Sustainable Management and the Resource Management Act".

The Resource Management Act, passed into law in 1991, promotes the concept of "sustainable management of natural and physical resources".

The one-day seminar has the objective of developing the concept of "sustainable management" in the context of this new legislation from the point of view of those who will have to implement it in practical engineering and planning situations.

The following statement appeared in a paper presented at the 1992 IPENZ Conference by John Buckeridge entitled *Sustainability: an Impetus for Ecocentric Engineering* which is particularly appropriate to the subject to be addressed in this seminar:

> "New Zealand's Resource Management Act has clearly defined the direction of future land development for New Zealand as essentially one toward 'Sustainable Management'. The central tenet of Sustainable Management is to preserve, and where possible, to enhance the environment in order to both maintain extant ecological processes, and to ensure the quality of life for future generations. Practising engineers, particularly civil or 'land development' engineers, will need to demonstrate an awareness of basic biological principles, and through this, to make an effective contribution to decisions related to both risk and irreversibility."

The sponsorship by Telecom of this seminar as part of their overall sponsorship of the 1992 IPENZ Annual Conference is gratefully acknowledged.

J. P. BLAKELEY
EXECUTIVE DIRECTOR
CENTRE FOR ADVANCED ENGINEERING
UNIVERSITY OF CANTERBURY

INTRODUCTION

Dr Rob Aspden

Thank you John. Welcome, everybody. It's great to have this opportunity to stress the importance that the engineering profession feels and wishes to stress about the question of sustainability and about questions of the environment. It's not always obvious that the engineering profession is concerned about the environment and as a profession they're an easy target as far as apportioning blame for problems that occur in developments and so forth. It is a very difficult line that we, as a profession, have to tread and perhaps we sometimes use too narrow a definition, but we are looking to improve things for mankind. As I say, what we are learning and what we are anxious to learn, is how to best do this, not just in the short-term but in the long-term.

Those of you who were present at our Conference would have attended the Presidential Address (Alan Bickers, Immediate Past President, is here as well and I think this also underlines the importance that we give this topic) and you would have heard Alan stress a commitment by the Institution, and by the profession, towards addressing these matters and recognising a sense of urgency. Those of you who attended the session yesterday morning would have heard something of the process that was going on and I hope would have understood just how large a part IPENZ has played in this. Right at this moment we have one past president, David Thom, working in Venezuela on matters relating to the forthcoming UNCED conference "The Earth Summit". We had Murray Sweetman here with us yesterday and he and I are heading off to Manila, where questions of the environment are also going to be addressed. He goes straight from there to New York to participate in the PrepCom 4 Conference (that is perhaps a bit of jargon that some of you will be familiar with - I hope most of you are) because there has been an extensive series of consultations and preparations for the Earth Summit which is to be held in Rio de Janiero in June.

What we are talking about and what we are addressing today will be mainly the national response to sustainability, but what we are really talking about is a global response. I don't wish to be so pessimistic as to describe the Earth Summit as our last opportunity - I'm sure it's not - but it is a major opportunity for us, as a world, to deal with questions of the environment and sustainability and development of the lesser-developed nations in an integrated and global way.

IPENZ has, I believe, shown a very significant commitment, because not only has it participated in the national programme of considering and preparing for the coming Earth Summit, it has also been a leader, together with the Institution of Engineers Australia, in preparing the document that the World Federation of Engineering Organisations will submit to the Summit. I believe that the Institution has a commitment and a great willingness and great practical involvement in the work that is going on towards the Earth Summit and, likewise, the question of sustainability. As John noted, with the establishment of the sustainability committee in Christchurch, the committee yet to be established in Wellington is in fact the environmental policy committee. It hasn't been established, but a task group - an energy policy committee - has been established as one of the first priorities, and that committee has already participated in discussions on the Energy Sector Reform Bill and is also looking to edge the Government towards making some sort of a national policy on energy as well.

I hope from these few comments you can see that, as a profession, we are committed to this; it may not always be apparent, but we are always ready to listen, discuss and to see ways in which we can actively move towards sustainability. I am looking forward to the day's activities. Thank you very much.

Dr John Peet, University of Canterbury

"A Theoretical Framework for Sustainable Management"

It is a pleasure to be here today and to share with professional colleagues and friends some things that have been going through my mind. Before I do so, may I say that although the title given in the programme is mine, I gave it to John Blakeley off the top of my head. I realised afterwards that, as a professional engineer and professional scientist, I am really not hooked into theoretical frameworks; I am hooked into good empirically-based scientific frameworks and that's what I'm going to talk about.

"Sustainable Management and the Resource Management Act" is the title of this forum and, obviously, the point is to indicate the connections with the Resource Management Act 1991. This emphasises that sustainable management does not exist in a vacuum; sustainability is a long-term aim. It means something like the preservation of a decent and, presumably, reasonably full lifestyle for humanity and all other life forms on this planet.

The fact that humanity depends upon other life-forms in many ways is something that should not need emphasising. I regret to say, however, that over the last twenty or thirty years there has risen to power a branch of political economics that has within it the implicit claim that humanity is developing towards a state where it will be independent of its environment. That idea is espoused widely by both the extreme political right and the extreme political left. It reflects some of the worst science fiction I have read since my childhood. It also reflects some of the worst of the 'pseudo-science' that is all too prevalent nowadays.

I must also point out that by 'sustainable development' I do not mean sustainable growth. Sustainable growth is a physical and biophysical absurdity. Growth, meaning an increase in size when measured on any scale that involves matter and/or energy (and they are both connected) is obviously not possible, because there are physical limits of finitude to everything. Growth in the use of resources and the production of pollution and damage to the environment is already excessive. Sustainable Development, on the other hand, is a reasonable and sensible concept that involves change in the quality and nature of things, and is possible either indefinitely or certainly for a very long time to come.

When I hear politicians talk about the need for sustainable *growth* in the economy I realise just how deep is the lack of numeracy and scientific literacy in society. Sustainable Development is something far more complex than just keeping Gross Domestic Product (GDP) rising. The inadequacy of GDP as a measure of anything of importance is another issue, to which I will refer later.

I am not going to attempt a definition of sustainability. We all know the Brundtland Commission statement:

> "Development that meets the needs of the present without compromising the ability of future generations to meet their own needs".

What does this statement mean? Right-wing economists and 'greenie' ecologists can both say they understand what it means, but in my opinion the two have no point of contact whatsoever. A related expression has been used in the Resource Management Act:

> "... sustaining the potential of natural and physical resources (excluding minerals) to meet the reasonably foreseeable needs of future generations."

That reflects some areas of political reality, but unfortunately it does not adequately reflect the whole system. However, let's acknowledge that the Resource Management Act is a useful step forward.

In order to look at the subject of sustainability, I will deal only with some parts of it. I am convinced, however, that we will never be able to put forward a truly meaningful index of sustainability. So if we are asked by politicians, economists and others to define sustainability, we will have to decline. Any economy existing within its ecological environment is a complex non-linear feedback system. You cannot pick on any key set of outcomes and expect an index to mean anything.

By a similar argument, GDP is an inadequate measure of economic welfare. It has been recognised as such for 50 years or so, but is still used. Is there nothing better? Of course there is, but there isn't anything simpler. It is a very bad measure of economic welfare. Many economists agree, but continue using it.

The American economist Hazel Henderson has pointed out that using something like GDP as an indicator of the health of an economy is rather like asking the pilot of a jumbo jet to take off with only one gauge on the instrument panel. Jumbo jet pilots are highly trained people who are experienced in interpreting a mass of information from a myriad of instruments. They integrate that information into an understanding of where the aircraft is in its surrounding air space and how it is progressing towards its destination. A jumbo jet is a complex thing, but it is far simpler than an economy which, in turn, is far simpler than an ecosystem.

To expect simplistic definitions of sustainability to have any meaning at all is, frankly, a fantasy. I would ask you, please, not to get sucked in by demands for it. Having said that, I am not suggesting that we do nothing. We need to understand what sustainability means in broad human terms, even if we cannot define it in engineering or ecological terms. We also have to have some foundation to stand on, before starting work to develop policies for sustainability.

The best description I have come across of the meaning of sustainability in human terms comes from the Dutch environmental scientist Bert de Vries. He states that:

> "Sustainability is not something to be defined, but to be declared; it is an ethical guiding principle".

That sort of background understanding is, in my opinion, quite consistent with what the engineering profession has been working on for years, with people like Dave Thom and Murray Sweetman. It is quite consistent, but it does not tell us what to do. How do we put it into action?

One of the first areas in which we can put it into action is by minimising unsustainable actions. We may not know what sustainability is, but we know that leaving toxic waste dumps for future generations is both ethically unacceptable and physically (and probably economically) unsustainable. There are many things in society that are known to be unsustainable. We may not know exactly where we are going, but we know enough of our immediate map to know where we should not be going. *Minimising unsustainable actions* is a key element of that navigation exercise.

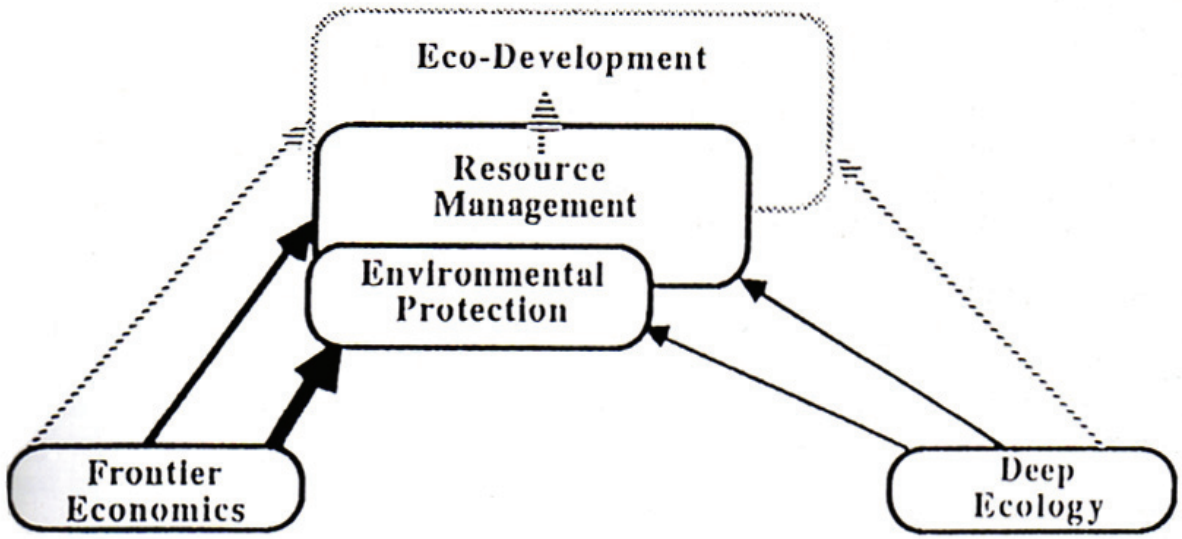
Having set the scene, I would now like to look briefly at some historical aspects of the process of developing environmental policy and go on to expose one of the major areas of pseudo-science that has been, and is still, strongly influencing Government and other policy-making, including the Resource Management Act (see Figure 1).

The evolution of environmental paradigms over recent years started with the realisation, around the middle of this century, that the 'frontier' economic stage could not go on forever. The

'cowboy' economy, the idea that nature was there for the taking, goes back to John Locke and the utilitarians in the 17th century. Everything was there for the taking; there was always somewhere new to go - and there was always somewhere to throw things away to.

The deep ecology movement is at the other extreme. The idea that some important points must be taken into account where the environment is concerned eventuated mainly during the 50s and 60s, and was enacted in legislation for environmental protection. Although there has been a move towards deep ecology, the thickness of the economic arrow in Figure 1 indicates the strength of the economic paradigm.

Figure 1 : Evolution of Environment-development Paradigms



(M.E. Colby, *Ecological Economics* V.3, No. 3, 1991, pp. 193-213)

Environmental protection involved such things as the Clean Air Act, the Water and Soil Conservation Act and all the other Acts which dealt with bits and pieces of the problem. In other words, they dealt separately with the dirty outputs of the economic system.

We are now into the second stage. New Zealand is a pioneer in looking at resource management as a much broader concept than simply environmental protection. Resource management expands system boundaries and enables us to start looking rather more widely. I think the economic contribution is still excessive. We are now in an intermediate stage of development of a third paradigm which will incorporate a much wider understanding of the environment in which we live, as well as contributions from economics. This is not to rubbish one in favour of the other; it's to indicate that we need the strengths of both.

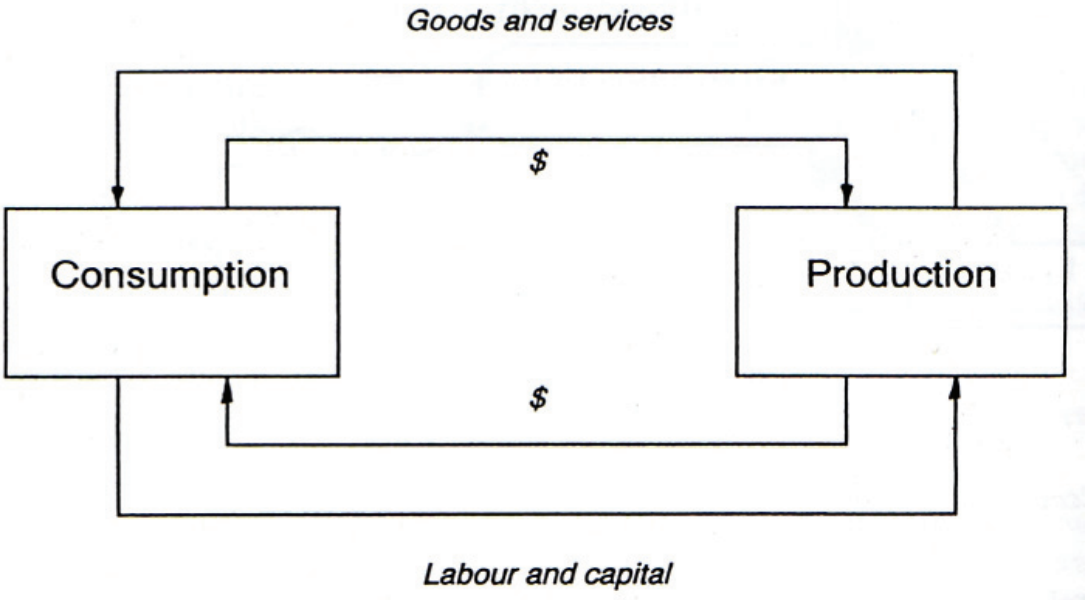
Having described one view of the development of paradigms, I would now like to discuss in more detail some views that come to us from the Western economic tradition (see Figure 2). This figure shows the neoclassical production model of a society. You will find it in one form or another in virtually every Economics 1 textbook. The production sector is, in effect, industry. It

produces goods and services for the consumption sector, which is effectively household consumers (plus government, exports and fixed capital formation).

In exchange for physical goods and services, money flows in the reverse direction. In order to get that money, the consumption sector has to sell its labour and its savings (for interest and/or dividend payments) to the production section. It is a closed system and it works - in some ways - quite well.

The relationships between the goods and services and the dollars paid for them, and the labour and capital and the dollars paid for them, differ markedly depending on whether one is in a capitalist system (to which the neoclassical economic model strictly applies) or in a Marxist-Leninist system. In a capitalist society, goods and services and dollars are linked through commodity markets. Labour and capital and dollars are linked through labour and capital markets. Most of these decisions are made by the Central Planning Committee in a Marxist-Leninist economy. In both, the overall process is seen as existing virtually in isolation, as a closed system. In other words, production and consumption are social processes governed by the economic system.

Figure 2 : The Neoclassical Model



Money is a marvellous invention. It enables us to take the millions of goods and services and the millions of labourers and capitalists in a society, and bring all of these activities together in terms of one number system - the dollar. We can add up the debits and credits, we can set up whatever accounting system we like, but we still have one unit of measurement - a numeraire, as they call it in economics.

The problem is that it does not take long before people, savings, goods and services, and the activities associated with their production and consumption, begin to be seen in terms of the dollars they *cost*, rather than in terms of the services or the people they *represent*. We have dollars worth of this and that, not people, or books or loads of bricks. Herman Daly, a World Bank senior environmental economist, has pointed out that money is now being seen as what sociologists and psychologists describe as a fetish. The symbol has become the reality.

Have you noticed how much time is taken up in the newspapers, and in the television and radio news, on the latest movements of 'the market' and other reflections of casino capitalism? These reflect not the reality, but the symbols that purport to represent the reality.

The gap between the symbolic representation of society and the physical reality it represents is, in my opinion, getting wider. One important outcome relates to the question of growth, because money put in the bank earns compound interest in perpetuity, if it is left that long. Most engineers at some stage of their careers have worked out that if Captain Cook had put a dollar in the Post Office at 10 per cent, by now it would be worth 20 million dollars. You can work this out on any reasonable sixth-form calculator. It's absurd, but exponential growth *is* absurd.

To the best of our knowledge, only money follows the rules of exponential growth. But when you start representing the reality of production, consumption, goods and services, labour and capital as a symbol which in itself can obey the laws of compound interest, soon everything else can obey the law of compound interest. Growth is a perpetually-growing circular process without constraints. To anybody brought up in the scientific real world, this is an absurdity; to anybody who has been brought up in the symbolic world of fetishes, it is perfectly reasonable. Once you get into that frame of thinking, it is very easy to see the world as something in which economics can be applied everywhere, and that is one of the reasons why engineers and economists cannot communicate with each other. We do not speak the same language; we do not even seem to live in the same world.

I understand that some forms of fetishism are discussed in psychological textbooks in terms of something approaching a perversion. As far as I am concerned, if it is indulged in by consenting adults in private that is one thing, but when it is imposed on society as a whole it is another.

According to Herman Daly again, if we see the economy as existing within its surrounding physical system, then what we see is that the total environmental system within which we live is sustained by flows of solar energy and virtually nothing else.

The standard response to concerns about the environment, or indeed anything else, from mainstream economists is to say: "Let us expand the boundaries of our economic system to take everything into account. Let us price resources in the environment, and then we can bring everything under the control of markets". This is the basis for privatisation in many areas such as land and water. We do not yet have air privatised, but I am confident that the economists will come up with an idea about that before very long.

Textbooks tell us that this is a very 'efficient' procedure, but many engineers have discovered that the economists' use of the term 'efficient' bears no resemblance whatsoever to the engineers' use of the term. An efficient allocation of resources in an economy is one in which, as one economist has put it [1] :

> "... nothing more can be given to the hungry, the cold, the ragged and the homeless without incommoding the glutton, the miser, the usurer and the playboy".

That is also a completely consistent explanation for the actions of such bodies as the Business Roundtable. Social justice involves other criteria, but with a few exceptions the majority of conventional economics has no place in its theories for social justice.

As a response to this economic imperialism, the ecological movement has argued that we must pull back from our current economic boundaries, have massive reductions in population, consumption of resources and so on. 'Ecological reductionism' is the name for this response. No doubt you will agree that it does not appear to be politically realistic at the present time.

---

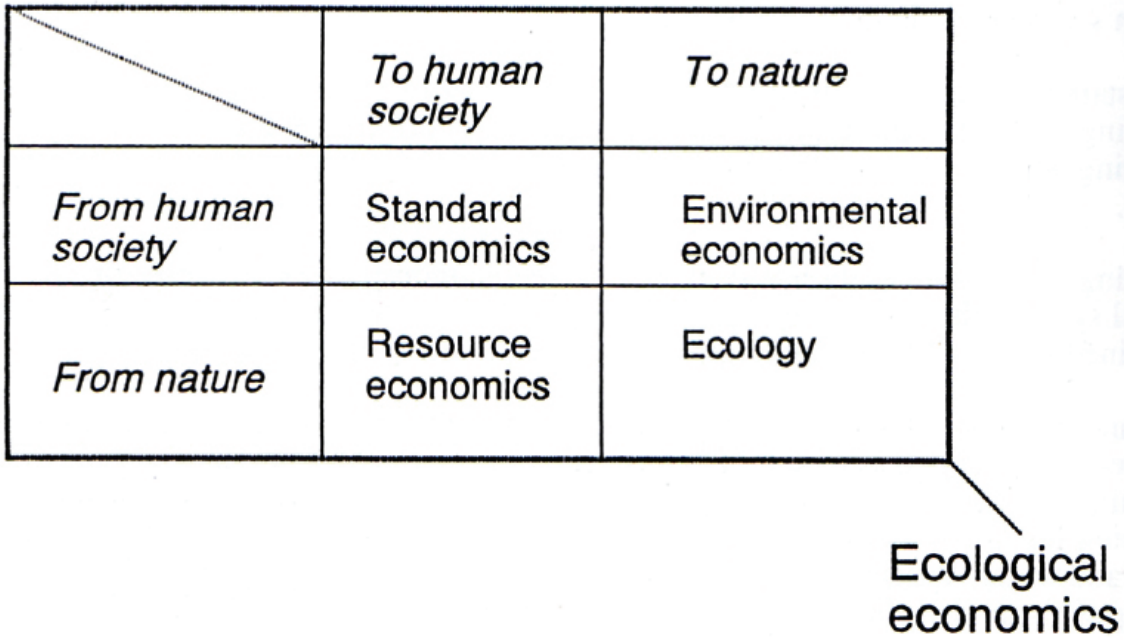
[1] Wiles and Routh (1984), *Economics in Disarray*, Basil Blackwell, Oxford p. 313

Economic imperialism is even less acceptable. I think the neoclassical economic paradigm has gone far too far already. In resource management, let alone eco-development, we do not accept either of these extreme models.

Just to complete what I am saying here, I would make the point that economics has come up with a number of different branches to deal with areas of the subject (see Figure 3). Standard economics deals with human-human interactions; nothing of any importance occurs outside human society. Everything important is socially valued and socially controlled.

Where we have interactions of humans with nature - in other words, where pollution is concerned - environmental economics has arisen. Where the use of resources from nature by human society is concerned, resource economics has been the response.

Figure 3 : Branches of Economics



The study of how nature interacts with nature is known as ecology. You will all be aware that economics and ecology come from the same Greek linguistic root - *Oikonomia* relates to the management of the household and *oikologia* to the study of the world. Basically, the two should be close together, but regrettably this is not so in practice.

The budding discipline of ecological economics attempts to integrate all of these, to look at the whole human-nature system. This is an area where, I believe, engineers have considerable ability to contribute and should not be scared off by the term 'economics'. We must stand up against mainstream economists and insist that there are other ways of measuring things than by money.

In saying this, I want to expose you to a saying of one of my favourite American writers, Artemus Ward, from over a hundred years ago:

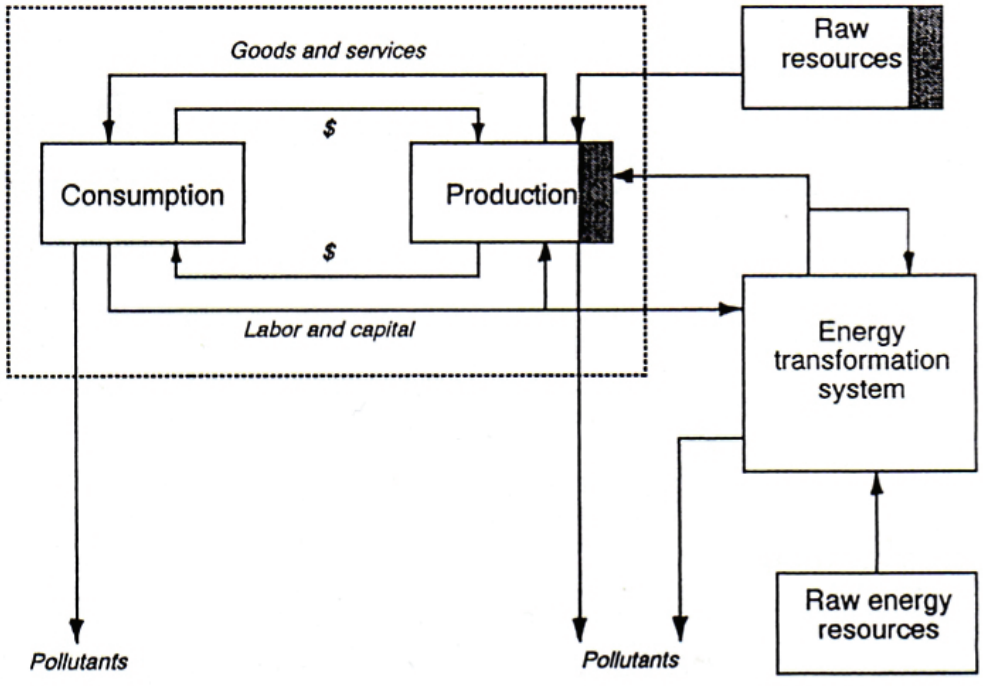
> "It ain't so much the things we don't know that get us in trouble, it's the things we know that ain't so."

That's a nice little statement and I think it's very relevant to the areas in which we are working. It's the things we know that ain't so that get us in trouble.

Now I would like to show you how some engineers have looked at the issue. You will remember the neoclassical production-consumption model I showed you a little while ago, that one with a closed circle (Figure 2). Anybody who is physically and thermodynamically literate knows that nothing physical happens in the world without the expenditure of available energy and the rejection of waste energy. 'Thermo' was a pretty heavy unit for most of us in our undergraduate courses, and for a lot of us there were times when it went completely over our heads. I think, however, there are some fundamental points that all engineers are aware of, as was shown by the American civil engineer Martha Gilliland some 15 years ago (see Figure 4).

In this model we see the production and consumption system as at all times totally dependent on flows of resources from the environment, and the use of resources at all times associated with the production of pollution. If matter and available energy flow into the system and are processed, then by the laws of conservation of matter and of energy, 'waste' matter and energy will flow out of it. Some of the matter and energy can be stored for a while in capital structures, but eventually these decay and will go out of the economic system. Production, in particular, is supported by the taking of raw resources - such as iron ore, timber and agricultural produce - from the environment. Everything that happens is made possible by the consumption of available energy.

Figure 4 : The Gilliland Model



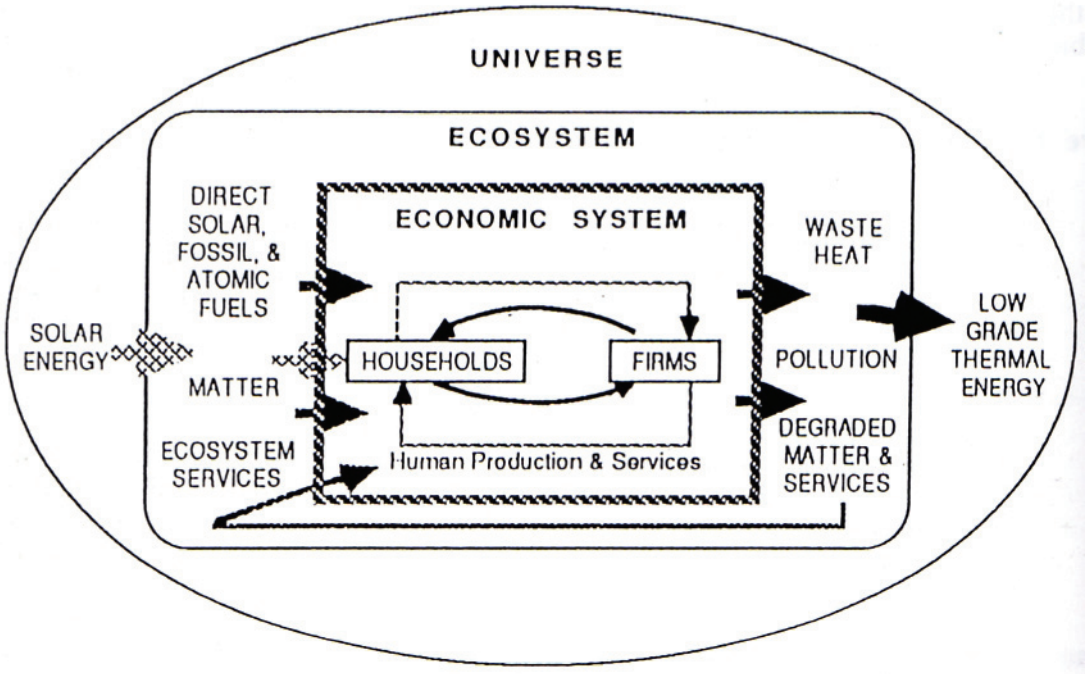
We keep matter and energy separate because, in physics, they are separate. In terms of economics, if they can be bought and sold in a marketplace there is no difference. I have a copy of a Treasury briefing paper to Cabinet from a number of years ago which made the assertion that energy was no different from cheese or toothpaste. Since Treasury work is not subject to peer review, and since Treasury briefing papers are not seen by anybody else (this one fell off the back of a truck!) this sort of scientific illiteracy is not picked up until a lot later, if at all.

That particular paper resulted in the demise of the Ministry of Energy and the adding of the leftovers to the back-end of the Ministry of Commerce. Scientific illiteracy rules, OK?

The Gilliland model expands our understanding of the system so that it is consistent with known scientific and engineering principles and widens our horizons considerably. I am delighted to say that it was first derived and published by a civil engineer. The message that comes out of all this is that system boundaries have to be addressed carefully. If we don't know our system boundaries, then we don't know what our system is. Engineers know this well in all situations involving a design problem, a control problem, or anything else.

That model of Martha Gilliland has been taken further (see Figure 5). This is quite a complex figure, but it points out that the economic system exists within an ecosystem which, in turn, is part of the solar system and the universe. Virtually all of the useful energy that we have in our system, and all of the energy which sustains us, comes from elsewhere - the sun. It doesn't come from within the economic system.

Figure 5 : Colby Model



(M.E. Colby, *Ecological Economics* V.3, No. 3, 1991, p. 205)

Over millions of years, solar energy has enabled the accumulation of fuels - ordered matter. We have been using fuels at an enormous rate for about the last hundred years, and particularly in the last 30 to 40 years. This process has enormously increased the amounts of pollution and degraded matter flowing into the ecosystem.

From Figure 5, it is clear that resource management is not a matter of 'balancing' the environment against economic factors. In real life, the idea of a balance is absurd. We have a hierarchy here, and balance is not possible in a hierarchy. In a hierarchy some things are subservient to others and their relationships are, in most cases, complex and non-linear.

Figure 5 shows that the circular process of production and consumption that is fuelled by energy and matter from the environment also produces products which, through feedback mechanisms, can be expected to influence - and may actually destroy - the very ecosystem services that clean up the air and water that we need for our living. A few years ago, fuel supply was seen as one of the most important issues facing us. Nowadays, while it is still regarded as relevant, ecosystem services are seen as more pressing. The ecosystem services problem is the generalised problem, expressed locally and globally in the form of global warming, ozone depletion, acid rain and so on. In New Zealand we are isolated from much of it, but ecosystem services damage is appalling in most developed and developing countries, and some of their future development opportunities are probably more constrained by ecosystem services damage (to soil, water, air, vegetation and so forth) than anything else.

If we take the model (Figure 5) of the economy within its surrounding ecosystem, then for long-term sustainability the economy must become a steady-state subsystem. But steady-state doesn't mean static. We physical scientists know that there is conservation of energy and of matter. As a chemical engineer, I tend to see the economy as being - in a sense - a tank which is fed by raw resources, heated or otherwise agitated by energy, and with physical outputs. Most engineers recognise that the outputs of pollution and damage are a direct consequence of the inputs and are two sides of the same coin - the two cannot be separated.

In terms of the future, it is flows that are important and this is what we need to concentrate on in developing environmental policy. This also brings us to a realisation that 'end-of-pipe' technology is much less effective than 'beginning-of-pipe' changes in technology. We can tack on control devices to the end of dirty processes, and this was commonly done using technology which concentrated on volume of production rather than the efficiency of the process.

In the last few years, industry has begun to concentrate on improvements in technology and on minimising inputs for a given output of product. This, of course, is normal technological progress, but it does mean that we also have to be careful about listening to people who say the costs of implementing pollution controls are high, and the results may not be commercially viable. In my opinion, if an industry emits pollution other people are already bearing the costs and the problems will come home sometime.

In its essence, Figure 5 is, I believe, consistent with the Resource Management Act and is strongly at variance with the traditional model of economic development. Many aspects of the moves for 'reform' of the energy sector - the virtual destruction of public transport and the deregulation of road transport - have supported the outdated economic model, directly contrary to the biophysical systems model. The Resource Management Act, the Ministry for the Environment, the Parliamentary Commissioner for the Environment and others are saying one thing, and other policy development sectors are saying another. 'Balance' is being attempted, instead of recognition of the hierarchy.

In order to start pulling things together and leave enough time for discussion, what I would like to do is put forward the view that the throughput of matter-energy across the environment-economy boundary is the prime issue to be addressed; that is precisely the area where engineering expertise is most needed and most relevant. How we harness that engineering expertise and how it is encouraged to act is where economics may be strongly involved, but the technology and the need for it are fundamental scientific issues which have nothing to do with economics.

Having said that, there is a policy hierarchy that we need to address. The primary decisions that we face depend on the physics and ecology of the environment and are based on an understanding of what is possible in nature. Physics and ecology constrain us; they do not say where we can go, but they certainly say where we cannot go.

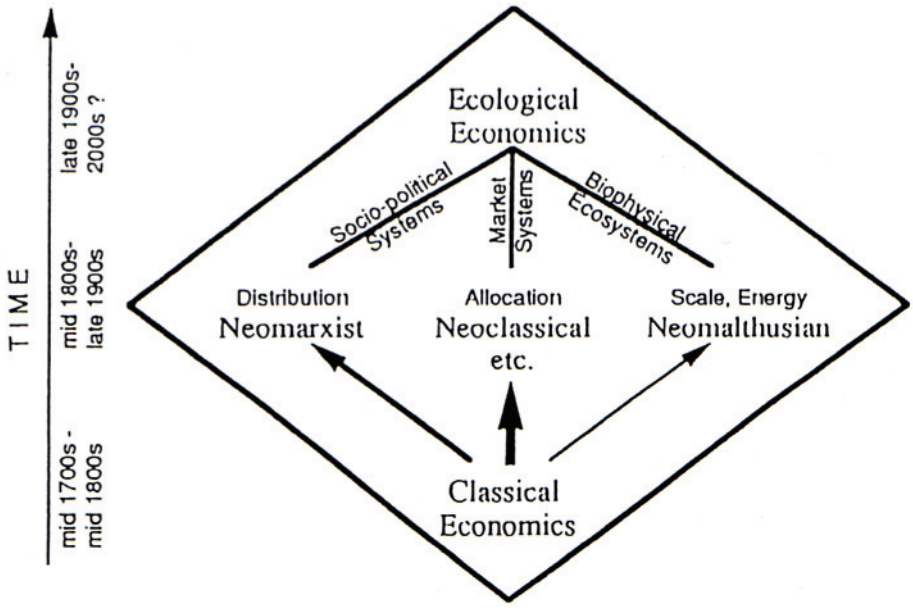
Having understood those scientific points, the secondary decisions are ethical. In what direction should we be going? What are our responsibilities to other life-forms? Do we want a country covered with green concrete or green trees? Should they be pinus or beech? These are ethical questions which reflect both humanity's power to destroy and its lack of power to recreate ecosystems. They come from within communities and societies. I believe a properly resourced democratic process is the way to find out.

Then, having first gone through those two stages in the hierarchy, we reach the third stage which is the allocation of resources. How do we do what we have decided is (a) possible and (b) ethical? That's where economics, engineering and technology come in. But at present, economics is involved in the primary decisions, because Treasury is incomparably more powerful than the Ministry for the Environment in advising Cabinet. The tail is wagging the dog.

Now I believe economists have an enormous contribution to make, but their contribution is - in general - not in the first two stages of policy development. By the same token, I do not believe that sustainable development in New Zealand will be achieved by using the fantasies of some of the engineers of the old school. You may remember some ten years ago, the plans for dams, power stations and coal mines the length and breadth of New Zealand.

In order to pull a number of things together, I would now like to show you another diagram, showing some aspects of the evolution of economic paradigms. Classical economics, building on Adam Smith's work, arose in the 1700s and was very strong to the mid-1800s. It then split three ways (see Figure 6).

Figure 6 : Evolution of Economic Paradigms



(M.E. Colby, *Ecological Economics* V.3, No. 3, 1991, p. 208)

The neoclassical approach arose in the middle/late last century as the capitalist response, concentrating on the allocation of resources. The most (indeed, the only) important resources were labour and capital. Neoclassical economics in its various forms and clones is still dominant in the Western capitalist world.

The Marxist approach concentrated on distribution. It achieved quite a lot of equality for a while, but basically was taken over by gangsters. In terms of its ability to produce, it failed.

The Malthusian approach followed the Reverend Thomas Malthus who looked at the breeding of rabbits and suggested that humans will soon exceed the space available to them. For the next 150 years his ideas were rubbished by the fact that technology, courtesy of engineers and so forth, had been able to increase food production enormously from a fixed land area. Conventional economists have concluded that this is possible indefinitely. Neo-malthusians say it can't last forever. Concentration on issues of land and, in particular, of energy are now becoming extremely important but the thickness of the arrow in Figure 6 reflects its relative lack of importance; it is still a thin arrow.

It is the hope of a number of people working in the field of ecological economics that all three paradigms can contribute their bit to the creation of an economics that goes beyond all of them. That could be one in which, with proper attention to questions of scale and the biophysics of ecosystems plus the use of market systems (which are enormously powerful), issues of environmental and social equity and efficiency can be brought together.

The aim is to use a combination of approaches and not attempt to produce a 'super tool', but have separate tools standing alongside each other. A good craftsperson has a bag of tools, not a single super tool. But a carpenter, even with a good tool kit, is of no use without a plan. I believe that by attention to objectives, possibilities and the hierarchy of opportunities we can make a much better job of starting to plan for the future. One of the first things to do is to get good science at the base of what we are doing.

DISCUSSION

John Blakeley : *It is amazing that over all these years there has been so little communication, it seems, between economists and scientists and engineers about their models being so different. Why do you think it is that around the world there has not been more communication between these two opposing views?*

John Peet : Not being an economist I can't say a lot about this, but for those of you who are interested there are three important books by Herman Daly: *Economics, Ecology, Ethics; Steady-State Economics;* and, (with John Cobb) *For the Common Good*. There are many areas where the empirical base of economic theory is seriously defective, but the establishment has a rigidity, a self-regulating capacity that prevents people getting out of it. It is actually very difficult to shake a system that is very rigid. The whole system of publication and promotion, particularly in USA universities, depends upon toeing the party line.

The second point is that in many areas of economics, people like Milton Freedman, Julian Simon and others have actually redefined 'science' to suit themselves. In the words of Mark Blaug who wrote a book on the philosophy of economics a few years ago, economists "... play tennis with the net down". Another economist, Peter Wiles, claims that it is possible for a science to be sick, and theirs is. There are other areas where economics is in disarray in terms of its underlying theories, because not one theory demonstrably survives the test of falsification. It is a fundamental requirement of science that all hypotheses are tested in a way that enables their falsification.

Paul Dalziel, Senior Lecturer in Economics at Lincoln, recently made the point that macro-economics is only 40 years old, and is roughly at the stage physics was at the time of

Copernicus. They are not scientifically sure whether the sun or the earth is in the centre of the solar system, but they have an enormous establishment saying the earth is at the centre.

Dr David Painter : *The reason I feel brave enough to come up and use the microphone is that while I agree with almost everything you said in the prepared part of your talk, I don't see very much point in shooting all the economists; we only have to climb over the heap. It would be far more positive if we recognised the limitations in our own understanding and in theirs, and look for a means to get from where we are now to where we should be. So the steady-state subsystem is really a quasi-steady-state subsystem.*

John Peet : Yes. It is indeed a long-term steady and not a short-term static model.

David Painter : *So it is definitely long-term steady. Where do we look now, as engineers, at what we can contribute? Do we look for prototypes? Is there anything that is more useful to us than the system that is currently being managed by the New Zealand economy?*

John Peet : The first part of my answer is definitely to emphasise the importance of the steady state. If we recognise that a function of engineers is to use technology to reduce flows of energy and materials, then the most obvious way is by better efficiency. The second is by introduction of better technology, but more important than all of these is, of course, to set up the basic goals of society in such a way that these are achieved.

This is where the hierarchy thing that I was talking about comes in. If we see the hierarchy as one which first of all depends on physics and ecology, then we must support and indeed promote policies that put science and ecological understanding first. The moves by the Government and the previous Government in terms of CFCs and ozone policy followed this hierarchy. They didn't ask the economists, they asked the scientists and the meteorologists who put it to them bluntly that this is a real problem, and we should get stuck in.

The same thing, up to a point, is going on in the context of global warming, except that the tail is beginning to wag the dog in that there have been absurd comments of draconian economic sacrifice in order to reduce greenhouse gas emissions. That is nonsense. We have known for decades that technical efficiency saves resources at a cost that is often very low, or even negative (that is, profitable). Dr Geoff Bertram of Victoria University, using OECD figures, has shown that New Zealand's Energy to Gross Domestic Product ratio (E:GDP) has been rising steadily while we have become an economic cot-case. Japan's E:GDP has been going down faster than virtually anybody else's, and yet they use 40 percent of the energy per unit of normalised GDP that we use. Their prices for energy are high, their efficiency is high, and as an economy they leave us for dead. I am not suggesting that it is a simple argument, but for goodness sake let us regard energy and material use efficiency as a keystone of economic strength, not as a something requiring draconian sacrifice.

As engineers, we have to concentrate on doing what we know best, but we can also insist on a level of scientific literacy in our decision-makers. We need an energy and materials policy that is related to biophysical reality and the Ministry for the Environment, with appropriate technical and professional advice, is the place from which it should come.

Prof. David Elms : *Just a couple of points I would like to make. I am very much in favour of your systems analysis, but wanted to offer a metaphor and a couple of warnings I think you should bear in mind. The metaphor is that of a game - not playing a game for fun, but playing*

a game for winning, like a game of rugby or something like that. What you do is set up rules, then you take these rules as a substitute for reality and then you play. What you are doing is bounded by this set of rules. This is very akin to the world view where people do this as groups and do that as individuals. One of the things to look out for is that, once you try to get out of the game you change the game rules. People who are into the game rules are going to do anything they can to stick with those rules and to get you to stick to the rules, if not to get you out of the game entirely. The minute you start questioning the fundamental game rules of some economists, they are going to play hard and they are going to play dirty, and more and more they might try bringing down the whole house in order to prove that their game of the world view is the only one.

John Peet : I've just remembered that my Chief Executive Officer is an economist. I'll just have to watch him!

Derry Gordon : *I'd like to follow on a little bit from something that David Painter was saying about the system being quasi-steady-state. It seems to me that ecological sinks are giving us the message that they are not infinite. It's those things we need to watch; they give us the limits to how far this steady stage can be abrogated.*

John Peet : I entirely agree with you and Dave; the term 'steady-state' is not a good term, but we haven't thought up a better one. In fact it is dynamic, because at all times you've got flows, sources and sinks and stocks which are decaying. Once you start thinking like that then you've got to be aware that you have feedbacks, and positive feedbacks are all potentially destabilising. The question of stability seldom comes into normal thinking. Secondly, we have non-linearities and discontinuities in our system which, again, conventional ways cannot cope with. As engineers, we know it; we know one can saturate a system; we know one can reach a boundary at the edge of linear behaviour, where one goes into sometimes violent non-linear behaviour. Nature behaves like that. Conventional political economics cannot cope with it. We've got to bring our engineering knowledge into the subject, and insist on being heard.

Dr Tom Fookes, Principal Analyst, Ministry for the Environment

"A Guide to the Resource Management Act with Particular Reference to Sustainable Management"

Setting the Context

Before launching into the Resource Management Act 1991 there are some matters of context which need to be addressed. Some of these were discussed recently in a paper by Dr Roger Blakeley, Secretary for the Environment, to the Engineers for Social Responsibility National Conference [1]. In that address he explained that: "Objectives of economic growth, sustainable management of resources, and social justice all come together in one concept - sustainable development." And to achieve that requires "...the integration of environmental, social and economic factors into the mainstream of decision-making in all sectors, at all levels ..." ; or:
"Put simply, we can have economic development over the long-run only if we maintain the long-term health and integrity of the environment."

The 1987 report of the UN World Commission on Environment and Development (the 'Brundtland' Commission) titled *Our Common Future* defined sustainable development as:

> "...a process of change in which use of resources, the direction of investments, the orientation of technological development and institutional change are all in harmony and enhance both current and future potential to meet human needs and aspirations ." [2]

The underlying philosophical thrust of *Our Common Future* has been widely debated since 1987. Engineers are one professional group in New Zealand that has accepted sustainable development in so far as it has been included in the IPENZ Policy Statement on Environment.

Those of you who have been tempted to test whether the *Listener* is something you can't put down may have caught up with the latest (24 February) issue and its feature "Last Chance for Planet Earth". If you have, then you will be familiar with Gordon Campbell's reporting of the Minister for the Environment's views on responding to the challenge of a sustainable future. For those of you who haven't got to that issue yet I will repeat the reported observation by the Minister:

> "New Zealanders...will recycle, plant trees, and support programmes to save endangered species. These are quite easy to do and imaginative. But when it comes to alternative fuel use or alternative transport use their enthusiasm tends to diminish quite rapidly. We're not doing very well on the things that involve uncomfortable personal choice. "

And Campbell adds that: "One of the best ways of cutting CO_2 levels (Mr Storey suggests) is to ride public transport to work." [3]

Sustainable Society

If we bring the Blakeley and Storey contributions together the sign post seems to be saying 'This way to a sustainable society'. But it is a society which requires "uncomfortable personal choice". And, if we accept Campbell's argument on the tension between North and South, a radical response from the North's industry as well as individuals is required.

Delving further into the *Listener* reveals "A Sobering Experience" [4], an article by Derek Wilson on the NGO conference in Paris, which is a lead up to the Rio UNCED conference. His

experiences at the Paris meeting seem to echo mine at the recent NZPI Summer School on "Sustainable Cities"; we are faced with a major exercise to reconsider our individual and collective lifestyles and the values on which they are based. But what incentives do we have here in New Zealand to embark on such a road? Isn't it simply too difficult?

And, I hear some people saying "If the Government believes it is necessary, why doesn't it do something instead of leaving it to us?"

That last question leads us to the Resource Management Act.

The Resource Management Act

Purpose and Principles

The Resource Management Act 1991, which came into effect on 1 October 1991, replaced or amended many statutes affecting resource use in New Zealand. The purpose of the new Act is "...to promote the sustainable management of natural and physical resources." It brings together the laws governing land, air and water resources. Noise, land, air and water pollution are also dealt with, as is management of the coastal marine area and the environmental effects of mining. This integration means the environment will be looked at as a whole when authorities are planning and making decisions. The focus is on the effects which proposed activities will have on the environment.

All decisions made under the Act must be consistent with the purpose to promote the sustainable management of natural and physical resources. The word 'promote' is very important because it signals that we are talking about a long-term goal. In fact, a path along which we are now embarked, recognising that it will not be completely traversed for some time. To continue this analogy, there are important staging points along the way when specific objectives will be achieved. The instruments for achieving these intermediate and long-term objectives include, for example, national policy statements, regional policy statements, regional plans, district plans and all consent decisions.

In the Act, sustainable management means:

> "...managing the use, development, and protection of natural and physical resources in a way, or at a rate, which enables people and communities to provide for their social, economic, and cultural wellbeing and for their health and safety while -
>
> (a) Sustaining the potential of natural and physical resources (excluding minerals) to meet the reasonably foreseeable needs of future generations; and
>
> (b) Safeguarding the life-supporting capacity of air, water, soil, and ecosystems; and
>
> (c) Avoiding, remedying, or mitigating any adverse effects of activities on the environment."

An important aspect of this definition is that the sustainable management of the natural environment must not be compromised by social or economic goals.

A council's desire to promote employment in a town must not compromise environmental standards set to achieve sustainability. The council is not allowed to encourage industry by adopting ineffective controls on noise, water quality and waste disposal.

The term 'sustainable management' reflects the need to establish the level of impact or degradation that can be tolerated without affecting the environment's life-supporting capacity and the potential needs of future generations. Some have termed this concept the 'biophysical bottom line'. Others have challenged whether such a bottom line is achievable.

Identifying this life-supporting capacity is a challenge. Central government, through national policy statements and national environmental standards, will have a part to play in this. Likewise, regional councils must address this issue at a regional level.

Sustaining the potential of resources

Sustaining the potential of resources is about ensuring they are not used, or adversely affected, to the point where they are unlikely to meet the needs of people in the future.

Obviously, it is up to future generations as to how they meet their own needs. One way they can do this is by tapping into the resource potential we leave for them. Protecting productive soils from contaminants and fertility loss so that future generations are able to grow food, is one example of sustaining the potential of resources.

Promoting sustainable resource use may require more efficient use of resources through better production techniques or technology, or through reducing, recycling or recovering wastes. A company, for example, may need to develop a waste recovery programme in response to stricter waste standards. A council may need to develop a transportation and parking policy that encourages energy efficiency, or gives an undertaking to protect an historic precinct.

Safeguarding the life-supporting capacity of the environment

Safeguarding the life-supporting capacity of the air, water, soil and ecosystems is ecological sustainability. One aspect of this is improving the health of threatened ecosystems; for example, by progressively reducing the waste entering a harbour in order to restore shellfish beds.

Another aspect is ensuring ecosystems and resources are not exploited to the point where irreversible damage or loss occurs. The habitats and levels of environmental quality necessary to achieve this must be provided. One example is the maintenance of minimum water flows in a river so that aquatic life is not threatened.

Avoiding, remedying or mitigating adverse effects

Avoiding, remedying, or mitigating adverse effects relates to where decisions relating to use and development are made.

Although it does not establish a legal obligation, the terminology of section 5(2)(c) implies an order of importance. The phrase "avoided, remedied, or mitigated" spells out a requirement to ensure that any adverse effects of activities on the environment are minimised to the greatest extent possible.

In practice, this would mean that adverse effects should be avoided if at all possible (for example, no air pollution should be caused by a factory). If this is impossible, then the adverse effects should be remedied (gases are treated before release). When this is not possible, mitigation should reduce or alleviate the severity of the adverse effects (gases released only at night, and only when wind speed exceeds a pre-set value).

The philosophy behind this Act, therefore, is that only if we ensure that sustainability remains our yardstick in all decision-making, can social, economic and cultural well-being of people and communities and their health and safety be achieved.

Additional Matters

The environmental focus of the Act's purpose is further reinforced by a series of principles to be considered in achieving sustainable management.

Section 6 lists matters of national importance which must be recognised and provided for.

Section 7 lists a series of other matters to which particular heed must be given.

Section 8 requires that the principles of the Treaty of Waitangi be taken into account. There will be many instances where recognition of the Treaty of Waitangi, or of Maori cultural or spiritual values, will be consistent with sustainable management. The concept of Kaitiakitanga, or guardianship, is particularly important in this regard.

Achieving Sustainable Management under the Act

The Act establishes a framework of policies and plans to promote sustainable management of natural and physical resources. This focus is emphasised by sections 9-16, which place the use of land, coastal marine areas and water, as well as the discharging of contaminants, firmly within an appropriate policy framework.

Consequently, the Act places considerable importance on the preparation of these policies and plans. Community involvement is a significant part of this preparation.

Regional policy statements, and district and regional plans will guide day-to-day resource management (for example, the processing of a water permit or land-use consent application) along the path towards sustainable management. They will provide agreed agendas for action at regional and district levels.

The regional level

The purpose of a regional policy statement is to promote sustainable management by providing an overview of the resource management issues of the region. It will outline the policies necessary to achieve integrated management of a region's resources. The statement must be consistent with any national policy statements or standards. It should also be the vehicle for a constructive dialogue between the Regional Council, Territorial Authorities and Iwi in the region, and the community at large.

The regional policy statement defines the boundaries of sustainable management on a regional basis and ensures that an integrated approach is taken with all resources and ecosystems.

For example, soil and water conservation will be considered at the same time as land use. Setting objectives for a highly-eroded catchment could influence the style of land management and flood control works to ensure adequate land cover and protection for downstream communities.

The purpose of a district plan is to achieve sustainable management with respect to land use. There may be localised policies (for example, to ensure pleasant and safe residential areas) and policies consistent with a wider regional agenda for efficient land use (for example, subdivision and urban 'infilling').

In working through what sustainable management means for the district, Territorial Authorities need to consider the definition in the Act, the regional policy statement, any national policy statements or standards, and what the community thinks is important.

The underlying goal of a district plan is to ensure that, in pursuing the Territorial Authority's broader objectives, the activities undertaken in the district work to promote the sustainable management of natural and physical resources. The Council's decision to build a sports stadium, for example, may conflict with noise and traffic standards proposed or in force for a particular part of a city. For this reason it is important there are clear links between a Council's annual planning round and the goals and objectives of the district plan.

The planning process

Sustainable management is an action-oriented concept. It requires priorities and issues to be clearly identified, with the outcomes the community wants for the environment expressed as goals. This requirement indicates that a strategic planning approach will be the key to the future of resource management.

Strategic planning requires a series of goals, reflecting what the community wants and consistent with any national policies or standards.

This means that each region and district must identify its own priorities in sustainable management. Then, based on these priorities and any national priorities, it must develop realistic ways of achieving these outcomes.

As already mentioned, a crucial element in sustainable management is the links between resources. Policy-making should not be a question of simply identifying issues in isolation from other related issues, but of identifying the connections between them.

Integration of policies, therefore, is a critical step in the policy-making process. For example, managing a flood plain must be integrated with recreational, ecological, and conservation factors, and adjoining land uses. In urban areas it will be no use protecting air quality if the result is that the waste is then dumped into the river or sea. Similarly, protecting residential areas from factory noise pollution won't work if an airport flight path is possible over the neighbourhood.

Greater public involvement in policy and decision making is one of the improvements brought about by the Resource Management Act.

Local authorities must consult with Iwi, other Local Authorities in their area, Central Government agencies and the wider community during the preparation of policies and plans. Furthermore, anyone can have a say in situations where a consent application is publicly notified.

Comparison with the Town and Country Planning Act 1977

It is important to recognise that the concept of sustainable management in the Resource Management Act introduces some significant differences from the way the previous Town and Country Planning Act 1977 dealt with natural and physical resources:

- there is no longer direct reference to the concept of "wise use and management of resources". This concept no longer applies, being replaced by sustainable management. An outcome of this change has been described as introducing a "more sharply focussed concept..." [5]

- the Act links many provisions to the phrase "use, development and protection". The elaboration of sustainable management in section 5(2) is one example. This can be interpreted to mean that:

"Resources are to be used, but in a sustainable way. That is to say, in a

> way or at a rate which enables social, economic and cultural aspirations to be provided for while meeting all three of the restraints of s.5(2)(a), (b) and (c)" [5].

- the emphasis in the Town and Country Planning Act on direction and control has been replaced by an emphasis on the control of effects.

- the inclusion of sustainable management in the purpose statement (s.5) means that matters of national importance (s.6) and other matters (s.7) "...will now have to be interpreted having regard to the overriding purpose of sustainable management in s.5" [5].

- while the Resource Management Act does not preclude socio-economic planning, it says that human activities must be carried out in a way that sustains the potential of natural and physical resources, safeguards the life-supporting capacity of air, water, soil and ecosystems, and avoids, remedies, or mitigates any adverse effects of activities on the environment (s.5(2)).

Urban Planning

In many ways, sustainable management is easier to conceptualise in regard to rural and natural resource issues than urban issues. Contrary to some speculation, sustainable management under the Resource Management Act is very much focused on urban resource use and development; that is, the built environment. In fact, the need for sustainable urban development is seen globally as one of the key components to achieving sustainable development.

The definition of physical resources under the Act includes energy and all structures, with structures being defined as any building, equipment, device, or other facility made by people and which is fixed to land. In Section 7, other matters include the maintenance and enhancement of amenity values, and the recognition and protection of heritage values of sites, buildings, places or areas, also strengthening the Act's provisions on urban issues.

However, the concept of sustainable management requires a change in focus by urban planners, with less emphasis on what is known as 'social planning' or 'social engineering'. The Act cannot be used to promote socio-economic goals for themselves, but rather must be applied in a manner that ensures the avoidance or mitigation of any adverse effects by resource use on prevailing social and economic conditions.

The population and activities of urban centres use or affect most natural and physical resources because most of this country's population, industry, transport and communications are concentrated in these places. Sustainable resource use will therefore have to be carefully considered in formulating urban policies. This means that, as they are reviewed, most district plans can be expected to have policies which seek to encourage increased density in order to improve the use of land, improve the efficiency of transportation and energy use, and other similar goals. The economics of servicing could also be a resource use issue for planners.

Urban centres also contain important natural resources, and these should not be overlooked. The volcanic landscape of Auckland, for example, or the estuaries of Tauranga Harbour are significant natural resources. The flora and fauna of our cities are equally important - urban areas contain important ecosystems which are often under considerable pressure from the impacts of human activities. Cities are also a major source of pollutants which can affect the natural resources far outside their immediate environs.

The third limb of sustainable management (s.5(2)(c)), avoiding, remedying, or mitigating adverse effects, will be a crucial aspect of urban planning. Resource management practitioners should be positive about using the opportunities provided by it. Striving to avoid, reduce or

mitigate any adverse effects of activities on the environment will require a response to a wide range of issues concerning the protection and enhancement of the environmental quality of cities. Both 'effect' and 'environment' have broad meanings under the Act, with the latter term including social, economic, aesthetic, or cultural conditions.

The concept of sustainable management demands an integrated approach to urban planning. Such an approach is probably best implemented through the preparation of a strategy or plan of action in which the long-term direction of development can be guided by a cohesive set of desired outcomes. These points are illustrated in the following case studies.

Case Studies

To illustrate the points made so far two case studies have been prepared. These are 'draft' analyses and only reflect the thoughts of the author. They should not be attributed to the Ministry for the Environment.

Case Study 1: Sustainable Management Applied to Peri-Urban Development

Purpose

This case study applying sustainable management principles to the problems of the peri-urban area addresses that stage of the policy process when objectives are determined. In this case the outcomes to be achieved by the objectives are as specified by items (a), (b) and (c) in Section 5(2) of the Resource Management Act. While each item has been considered separately it is acknowledged that in the Act they are intended to be applied collectively. However, if objectives as illustrated are considered as a set, related to each other, and are applied in full, this should achieve the intentions of Section 5(2)(a)-(c).

The aspects covered by the examples cross the boundary between the responsibilities of Regional Councils and Territorial Authorities. For example the first objective for the outcome "safeguarding the life-supporting capacity of air..." applies equally to decisions on land use consents and discharge permits.

Consequently, this case study is probably best read as a set of ideas which could contribute to the preparation of a regional policy statement although the ideas presented through it can be applied just as much to district planning. This case study illustrates the sort of framework a council could develop as a precursor to analysing its policy options. For example, the objective in Table 1 refers to activities not foreclosing future options for the use of quality soils and could be met through several policy responses of which setting minimum areas for subdivisions is only one.

Background

The problem of managing development in the peri-urban area adjoining towns and cities has been discussed elsewhere.[1]

This case study is being approached from the position that the problems for the peri-urban area are due to pressures from within that area (for example, land required for intensive farming and horticulture) and from the adjoining urban area (for example, land required for urban living). Responses to these pressures brings a wide range of effects on the environment as it is defined in the Resource Management Act. Some of these effects concern the natural resource base of

[1] An extensive review of this subject was undertaken in 1979 and 1980 by the Land Use Advisory Council with several published reports.

the region while others affect amenity values and the social and cultural conditions pertinent to the regional community (and possibly the country at large).

Objectives

The objectives referred to are set out in Table 1.

The outcome provided for in Section 5(2)(a) of sustaining the potential of natural and physical resources (excluding minerals) to meet the reasonably foreseeable needs of future generations can be considered for quality soils in the peri-urban area. It can also be applied to the urban area in terms of (i) public investment in infrastructure and urban services, and (ii) improving the urban environment so as to encourage urban consolidation rather than suburbanisation. The latter direction is intended to reduce the pressure from the urban area.

In order to achieve the outcome of Section 5(2)(b) concerning safeguarding the life-supporting capacity of air (etc), the overlap with item (a) should be recognised. If an objective has been set which also has the effect of safeguarding soils (as above) it should not be necessary to cover that resource again. In the example the objectives focus on (i) water quality, and (ii) the retention of indigenous vegetation and wetlands, in so far as they relate to habitat and ecosystem maintenance.

The outcome of Section 5(2)(c), avoiding, remedying, or mitigating any adverse effects of activities on the environment, could address such issues as amenity values and natural features, demand for and cost of public services, and the relationship of Maori as provided for in Section 6(e).

TABLE 1: SUSTAINABLE MANAGEMENT OUTCOMES APPLIED TO PERI-URBAN DEVELOPMENT

NOTE: The objectives are intended to illustrate the approach adopted in this example and do not cover all possibilities. Each objective has been written to apply to the need to respond to the resource management problems facing the peri-urban area, including specifying objectives for the adjoining urban area which could help reduce pressure on the peri-urban. Presented this way the table shows how to respond to rural-urban problems where initiatives need to be taken in both areas. Where an 'Objectives' includes a matter of National Importance (Section 6) or Other Matter (Section 7) this is indicated.

OUTCOME	AREA OF APPLICATION	
	PERI-URBAN OBJECTIVES	URBAN OBJECTIVES
Sustaining the potential of natural and physical resources (excluding minerals) to meet the reasonably foreseeable needs of future generations	To ensure that activities do not foreclose future options for the use of quality soils (relates to S. 7(b) and 7 (g))	To ensure that activities are developed to levels where optimum use is made of public investment in infrastructure and other urban services (relates to S. 7 (b)) To achieve a greater acceptance of urban living by enhancing amenity values and maintaining quality of the urban environment (relates to S. 7 (f))
Safeguarding the life-supporting capacity of air, soil and ecosystems (S. 5 (2)(b))	To manage activities to achieve the water quality standard required for "water managed for aquatic purposes" (criteria as in Third Schedule, RMA) (relates to S. 6 (c)) To manage activities to retain indigenous vegetation and wetlands which are significant for habitat and ecosystem maintenance (relates to S. 6 (c))	
Avoiding, remedying, or mitigating any adverse effects of activities on the environment (S. 5 (2) (c))	To minimise the effects of development on the amenity values and natural features of the rural landscape (relates to S. 6 (b) and S. 7 (c)) To balance the need to supply public services with the direct costs to community of their provision (relates to S. 7 (b)) To ensure that development does not adversely affect the relationship of Maori and their culture and traditions with their ancestral lands, water, sites, waahi tapu, and other taonga (relates to S. 6 (e))	

Case Study 2: District Plan Example - City Development Around an Estuary

The Issue

Land adjoining an estuary is facing development pressure from the adjoining city. There are many sustainable management 'dimensions' involved in this hypothetical example, such as urban growth and urban-fringe issues, conservation of the natural character of coastal environment, protection of important landscape features, management of water resources, and other important matters, including the location of waahi tapu around the estuary edge.

National and Regional Context

The district plan stands within a policy and regulatory framework consisting of national and regional dimensions. In addition to the national matters provided for in Part II of the Resource Management Act, there is the national coastal dimension addressed by the NZ Coastal Policy Statement. This provides a policy context for the use of the coastal marine area within the estuary, with a corresponding regional coastal plan. There are no other national policy statements or national environmental standards of relevance for matters such as water quality. The regional dimension to this issue is critical to ensuring the integrated management of resource use in and around the estuary on a sustainable basis. The regional policy statement is the primary instrument for translating the requirements of the Resource Management Act - particularly Part II (Purpose and Principles), Section 59 (Purpose of Regional Policy Statements), and the Second Schedule - into an agenda for action. As part of this process the statement identifies the main issues arising from the three components of sustainable management in Section 5, with particular focus on the requirements of Sections 6, 7 and 8. It identifies actions needed to meet these goals. Table 2 sets out some of the objectives for a sustainable metropolitan area.

In addition, there are policies relating to all five matters of national importance in Section 6, as well as issues arising from the other matters listed in Section 7. The traditional importance of estuarine areas and the coast generally means particular attention has been paid in the regional policy statement to the principles of the Treaty of Waitangi (Section 8) and the relationship of Maori and their culture and traditions with their ancestral lands, water, sites, waahi tapu, and other taonga (Section 6(e)).

From the regional policy statement has come a number of regional plans. Taken together the plans seek, amongst other things, to preserve specific natural features of outstanding quality, to preserve key elements of the natural character of the estuary, and to enhance public access and protect any significant indigenous flora and fauna in the estuary.

The regional coastal plan forms part of the regional plan because the regional council has considered this necessary in order to promote the integrated management of its coastal marine area and related parts of the coastal environment (RMA, Section 64(2)). Other regional plans have been directly derived from the regional policy statement and relate to functions or effects of activities or development around the estuary that are of regional significance.

One such regional plan contains an urban growth strategy to ensure sustainable urban development in an integrated manner for the case study area. The strategy seeks to intensify existing urban development by curtailing growth or directing it according to preferred patterns.

TABLE 2: OBJECTIVES FOR A SUSTAINABLE METROPOLITAN AREA

"At the metropolitan scale the interactions between land, water and air - through the use by people of buildings, road and rail networks, open space and natural features - has both beneficial and adverse effects. Avoiding, remedying, or mitigating the adverse effects of these interactions requires objectives grounded on sustainability principles. With such a complex thing as the city it is necessary to think in terms of objectives in several layers or a hierarchy. First-level objectives are:

(1) to maximise people's accessibility to each other and those places which provide for their needs and wants;

(2) to minimise expenditure of effort as measured in terms of energy, time and cost;

(3) to maximise health and safety through protection from such elements as noise, heat, and human aggression;

(4) to maximise opportunities to use while protecting natural and heritage areas;

(5) to strive for an optimum synthesis of the four previous objectives."

Policies to achieve these objectives include:

- containing the outward expansion of the city by encouraging medium and, where appropriate, higher density development designed to achieve positive environmental effects, such as enhancing community interaction, improving living environments for the aging population, maintaining viable trade catchments for existing commercial centres, and reducing the need for commuting by private cars;

- encouraging the appropriate use of land with high quality soils, including ecologically sustainable farming practices, while ensuring that the inappropriate use of these lands does not occur;

- locating new developments to maximise use of existing infrastructure;

- encouraging voluntary design standards (supported by regulations) to avoid adverse health and safety effects of activities while enabling people to mix residential and non-residential activities as part of the goal of constraining city expansion; and,

- identifying and promoting positive community attitudes towards sensitive ecological areas so as to avoid adverse effects on these areas. The plan also seeks to establish and protect broad levels of environmental quality such as the protection of regionally significant landscape features, heritage and other amenity values.

Other regional plans of relevance to this case study include a catchment management plan for the river concerned (including streams flowing into the estuary), an air resources management plan for the region, a heritage (including nature conservation) strategy, and a management plan for resources of significant cultural and spiritual value for the tangata whenua.

City Context

At the city level, urban development on the land surrounding the estuary is managed by a district plan. Coming as it does within the framework provided by the regional policy statement and

regional plans, it seeks therefore to achieve sustainable management objectives and policies in the regional policy statement while managing the significant resource management issues of the district.

Policies in the plan address questions on the nature of urban development in the vicinity of the estuary, such as the intensity and direction of urban growth, and the protection of natural and physical resources. Priority is given to achieving sustainable outcomes while avoiding adverse effects on resources which have high amenity values and contribute to environmental quality.

There is considerable community support for sustainable management policies that maintain and enhance characteristics contributing to the pleasantness, aesthetic coherence, and cultural and recreational attributes of the area. Included here are elements such as personal privacy, low noise levels, medium levels of population density, landscape features and ample vegetation cover, low traffic flows away from commercial centres, and the effective provision of public transport.

The district plan provides for large projects with potentially significant effects to be assessed against 'sustainability criteria' which can be used by developers to minimise conflict with regional and city objectives (see Table 3 - these criteria are explained further in the City's *Manual for a Sustainable City*). A housing project to achieve medium- or higher-densities, for example, will be evaluated according to its potential cumulative environmental effects, including those on the area's amenity values, on local ecosystems, and on the impact on the use of resources, including energy.

The regulatory provisions of the district plan are, in short, to ensure that development is in accord with the regional and district objectives and policies on sustainable management.

Complementing this regulatory regime are, however, a number of other ways which the City Council may use to achieve a sustainable city. The 'guide book' for these is the council's *Manual for a Sustainable City* which has been designed so that public or private sector development could proceed without the need for regulatory controls at every step of the way. It includes the council's environmental objectives which have to be applied to all of its own proposals, and identified in the Council's Annual Plan.

TABLE 3: SUSTAINABILITY CRITERIA FOR PLANNING DEVELOPMENT

"The following are criteria to be applied to new development in order to promote the sustainable management of natural and physical resources under the Resource Management Act 1991:

(1) Accessibility with Socio-Ecological Benefits

> *Natural and physical resources (including structures) have been brought together so that they are accessible to people living and working within them, and they can use and enjoy the resources in ways which are socially and ecologically beneficial to themselves and the community.*

(2) Conservation of Effort

> *The use of natural and physical resources (including structures) requires the minimum of effort, measured in terms of energy, time and cost.*

(3) Avoidance of Danger and Nuisance

> *The design of structures and public and private space provides effective protection from noise and heat, and other people's aggressive behaviour.*

(4) Nature and Heritage Values

> *Areas with locally acknowledged nature and heritage values require effective treatment in the interests of future generations, as well as safeguarding the life-supporting qualities of natural ecosystems, and protecting the area's heritage.*

(5)...."

Conclusion[2]

The Resource Management Act is notably different from the legislation it replaces with its clear and overriding purpose to promote the sustainable management of New Zealand's natural and physical resources.

With this change in purpose, it is clear that planning will require a refocusing of policy analysis and formulation. There will be aspects of the old laws that will be pertinent for the promotion of sustainable management, but there are also many opportunities for new approaches to be taken. Thoughtful and innovative work will be required in defining and prescribing appropriate objectives and policy techniques.

Sustainable management, as expressed in the Act, is a goal-oriented concept. It is a state to be achieved over time. This requires priorities and issues to be clearly identified, with desired outcomes expressed as objectives which are then pursued, reviewed and modified as necessary. Such a requirement, therefore, indicates that a strategic planning approach will be fundamental to effective resource management. This means each region and district has to explicitly specify its own priorities of sustainable management, and then, based on these priorities, develop realistic means for achieving these outcomes.

---

[2] Some of the ideas in this conclusion (and the section on urban planning) have come from a draft Guideline to Sustainable Management written for the Ministry for the Environment by Robert Schofield, Rankine and Hill, Wellington.

The concept of sustainable management involves such broad considerations that it would be totally unrealistic to attempt to achieve its purpose by applying the concept to every consent application. This is why Part VI of the Resource Management Act places such emphasis on identifying effects and complying with the policies and plans. This is why the principal application of sustainable management is through the development of policies at regional and district level. These policies provide the foundation for the assessment of all resource consents - decisions and actions that meet the goals of the plan would accordingly meet the overall purpose of sustainable management.

Within the framework of policies and plans under the Resource Management Act, regional policy statements have a pivotal role in implementing sustainable management. These statements provide the primary means of translating the broader intentions of sustainable management into an integrated policy for addressing the needs and issues of each region.

To return to Derek Wilson's article [4], the Resource Management Act should encourage us to reflect on the statement:

"People from across the planet are becoming the
caretakers of their own destiny... "

References Cited

1. Blakeley, Roger, *Economic Growth and Resource Management,* a paper presented to the Engineers for Social Responsibility, Eighth National Conference, University of Canterbury,16 February 1992.

2. World Commission on Environment and Development, *Our Common Future,* Australian Edition with the Commission for the Future, Oxford University Press (1990).

3. Campbell, Gordon, "Last Chance for Planet Earth", *Listener*, 24 February 1992, pp. 15-17.

4. Wilson, Derek, "A Sobering Experience", *Listener,* 24 February 1992, pp.18-19.

5. Randerson, Tony, "Part II - Purpose and Principles", in Allin, Fisher and Randerson, *Resource Management Act 1991*, New Zealand Law Society Seminar, September-October 1991, pp.2-14.

DISCUSSION

Dr John Peet : *Having submissions, having hearings and so forth excludes something like 99% of the community. There are procedures known in adult education, and I'll push a particular barrow here for the WEA movement, which are able to bring people together in a much more creative way; it's time consuming, but a creative way to actually make contributions that go far beyond the simple reviewing of submissions and so on. I'm sure it's not excluded under the Act, but what is being planned, what is possible in that area, in the areas of improving public input, insofar as you know in terms of the Ministry and related organisations - and I would mention the context that the WEA has lost all its funding.*

Tom Fookes : That is a very good question because we are progressively trying to respond to a number of audiences. Some two years or so back when we thought the Act was going to be passed then, we had a list of perhaps 25 different audiences and tried to work out a strategy of getting ideas and information to those. We are slowly working our way past the operators, the ones who put it into effect, and we are now moving progressively towards focussing our

attention on the wider community. It seemed to me that what you were also saying, was that the sooner we can get people appreciating what they can demand of the system, what they can expect, the sooner councils will start to respond in that way. So that's the first priority, trying to get information out about the Act into various journals, such as the *Listener*, the *Women's Weekly,* so that people know - what questions do I ask?

The Act provides the bottom line in a sense, it says these are the minimum, this is what you must do, but there is nothing to stop you doing all sorts of other creative things.

John Peet : *Could I ask - almost as an impertinence - have you run it past some other educators?*

Tom Fookes : We have to some degree, but not formally.

Mr Hans Versteegh, Strategic Policy Planner, Canterbury Regional Council

"Sustainable Management - A Regional Council Viewpoint"

I have been asked to speak on how the Regional Council sees its role in the development of good practices of sustainability. The views I am about to express are my own and not necessarily those of the Canterbury Regional Council. The reason for this is that I believe it would be premature for the Council to have fixed its views while it is still in the process of formulating its Regional Policy Statement, a requirement of the Resource Management Act.

The Regional Policy Statement, when completed, will in fact be an expression of how the Regional Council sees its role in the development of good sustainable management practices. The policy statement will define the Council's business in resource management by outlining the resource management issues and by accounting for how it will go about dealing with them in terms of the Resource Management Act.

The Resource Management Act when it came into force in October last year, introduced the concept of sustainable management into the arena of statutory planning. Sustainable management is the goal of the Act, and also the goal of all planning that is undertaken in terms of that particular Act. The Act in Section 5 gives meaning to the term and whenever the words 'sustainable management' are used the full definition, as set out in Section 5, applies. The Act also gave Regional Councils specific responsibilities towards the achievement of that goal. Essentially those responsibilities are directed towards managing natural and physical resources in a way that is integrated and sustainable.

Section 5, that is the purposes of the Act, contains a number of complex elements, concepts and interrelationships which, when applied with reference to the functions of Regional Councils, begins to define some of the roles for Regional Councils in developing good sustainable management practices.

For the purposes of this talk, I wish to focus on one of those elements which will become a driving perspective in the development of good sustainable management practice. If time permits, I will also discuss briefly the impact of Section 32 on the development of practice.

The reason I've selected this focus is because it highlights a contrast that exists in the legislation. In many ways the Act is quite specific as to the way in which sustainable management is to be practiced, and this is exemplified by the example I have chosen. On the other hand the Act is flexible as to the techniques and measures adopted in the implementation of resource management objectives.

The element of Section 5 that I wish to refer to today is that of 'enabling'. One of the first stated functions under Section 5 is a management one. The object of the management function is the use, development and protection of resources.

This management function must be carried out in a manner that "...enables people and communities to provide for their social, economic, and cultural wellbeing and for their health and safety...".

This enabling takes place while, at the same time, the potential of natural and physical resources to meet foreseeable needs of future generations is sustained, while the life-supporting capacity of air, water, soil and ecosystems is safeguarded and while the adverse effects of activities on the environment are avoided, remedied or mitigated.

In other words, there is an obligation in Section 5 placed on Regional Councils in the exercise of their functions and duties to ensure that people and communities are not disabled by the Council's pursuit of sustainable management practices. It is quite clear in my view that it is not a Regional Council responsibility, in terms of the Resource Management Act, to be pro-active in the pursuit of providing for people's social and economic needs. It is simply a matter for the Councils not to disable people from pursuing these unless it compromises the three axioms of Section 5(a), (b) and (c).

Just what does this concept mean in relation to the essential resources of land, air and water, given that Regional Councils have responsibilities for ensuring that the natural and physical resources of a region are managed in a way that is integrated and sustainable?

Dealing firstly with water

Under the Resource Management Act, unless provision is made in a regional plan, all significant uses of water are subject to a specific resource consent. Discharges of contaminants into water or onto land which could enter water are also controlled by process of the Act.

Thus, in the absence of a regional plan, there would effectively occur a 'locking up' of the water resources of a given region. In relation to water it is fundamental that Regional Councils, in the pursuit of ensuring sustainable management, make sufficient provision to enable people to provide for their well-being and health. This may require the adoption of water quality standards and allocation procedures, which will need to be developed in consultation with the community.

Or, for example, in the case of the application of pesticides, herbicides or fertiliser to land, the adoption of codes of practice to ensure that rural communities are not disabled from meeting their needs. The three axioms of Section 5 will also need to be met as an essential part of giving effect to the promotion of sustainable management.

Turning now to land

Unlike regional planning schemes under the Town and Country Planning Act, regional plans will now perform direct regulatory functions. Regional Councils have the power to control the use of land principally in the following areas:

- the use of land which is of regional significance;
- control of the use of land for the purpose of soil conservation;
- the avoidance or mitigation of natural hazards; and,
- the control of coastal land.

The situation in relation to the land resource is different to water in that the Act has already enabled the people and communities to make use of the resource. The land resource is already allocated through the private land market system. Regional Councils in the exercise of their powers in respect of land and the pursuit of the goal of sustainable management, will need to define and prove the need for intervention. Intervention should only occur in a manner which does not disable people from using land resources. There is a clear onus on Regional Councils to establish the link between the need to intervene and the environmental outcome sought. Intervention is most likely to be about defining private property rights.

Air

Regional Councils are responsible for controlling discharges of contaminants into the air. In the exercise of this function the Councils will clearly have a management role if it is not to disable people and communities from meeting their needs. For example, cars could not simply be banned from a city in order to curb an air pollution problem. A wider management regime would have to be put in place if people were not to be disabled.

Section 32

In developing good sustainable management practices, Regional Councils will also be very much guided by Section 32 of the Act. Section 32 is one of the most significant changes to the resource management regime put in place by the Resource Management Act. Section 32 requires decision-makers to consider alternative courses of action and to properly assess the benefits and costs before adopting any objective, policy or rule or any other method. Section 32 thus asks decision-makers to be very clear about the issues that are addressed and to properly address costs and benefits. Having decided on these they must assess the various ways these ends can be achieved. The council will need to be certain that the objective policy or rule will be necessary in achieving the purposes of the Act.

This provides for the first time a statutory requirement to check on the need for intervention at all, as well as a check on the nature of the intended intervention. Consideration is required to means other than regulation for achieving objectives. The section makes it clear that the alternative of taking no action must also be considered. This makes it quite clear that, in cases where the costs exceed the benefits to be gained from the outcome, then nothing should be done.

My experience to date of applying Section 32 to a wide range of issues shows that regulatory intervention will no longer be the cornerstone of sound resource management practice as it was under past legislative enactments. I believe that the future practice of resource management will be heavily reliant on the use of techniques such as education and economic instruments to modify human behaviour in the pursuit of sustainable resource management.

By way of a conclusion, I would just like to reiterate that the views I have expressed are just one interpretation of the way in which sustainable management ought to be applied by Regional Councils. I have driven it from the perspective of enabling, but it must be remembered that the Act consists of a complex set of interrelationships and to drive it from any one perspective without a consideration of the whole can lead to a distorted picture.

DISCUSSION

David Painter : *Hans, a straight forward question for a change. I noticed you go by a statement, which you said quietly, which I think was quite important and that is that you don't see it as the role of Regional Councils to be pro-active. Now I understand why you said that, you were talking about Section 5 at the time and enabling rather than imposing (my word); however I hope there are some areas in which you would see it to be role of Regional Councils to be pro-active. One of those which I'm asking about is community education and communicating possibilities to people. I think in many cases people like yourself and the staff will actually see possibilities that a lot of people who haven't been looking at the problem might not otherwise come up with, so I feel that as part of enabling to be pro-active about community education.*

Hans Versteegh : I would just comment on that by saying that the Regional Council has a very clear responsibility to educate if it is to achieve anything in terms of that goal in the legislation. To enable the community to actually address an issue can only be done through educative processes. Regional Councils will be able to use economic instruments to modify behaviour, and just the process of modifying people's behaviour alone may lead to a change in thinking; but generally speaking it will be through educational processes. When I used the term pro-active, it's pro-active in actually promoting, for example, employment schemes as a solution to a problem; if we start blaming the problems on the environment as being one of unemployment, then it's not our job to address that particular issue through the promotion of employment schemes.

John Blakeley : *Hans, my question simply relates to whether there is any conflict between the role of the Regional Council and the role of the District Council in administration of the Act. Is it very clear where one fits in relation to the other ?*

Hans Versteegh : In my view it's very clear, and that is from a position of fairly intensive analysis of the legislation. The functions the council has are quite specific, the powers are quite specific, the situation at the regional level is that we have those powers that I refer to - the power to control land under certain circumstances. Whether we do exercise them or not depends on the need for intervention. The districts have to deal with environmental effects so they've got a very clear role which is different from controlling land use, and it's going to take quite a few planners quite a long time to actually understand the change in emphasis. What they had before was control over a much wider range of issues, but they are now limited to dealing with the effects rather than controlling the use of the land. Needless to say when they pursue the control of the effects it will have an impact on land uses, but that will manifest itself as an outcome rather than an input to the process.

The situation that I see with the districts at the moment is that they are struggling to actually see what a district plan might in fact look like. They are still in the mode of trying to re-invent their old planning processes and make them fit into the mould of the Resource Management Act. A lot of the districts are using the apparent lack of progression of the regions as an excuse for saying, until the region gets its policies in place we can't do anything - you are holding us up. I think that's true to a degree, but I think it's not true to the extent that they do have responsibilities under the Act and they should be sorting out what these are and determining how they are going to tackle them. At the same time we are defining what our policies are on land, air and water and acknowledging that they do have an impact on districts. These we will be making known at the earliest opportunity but it still doesn't absolve districts from sorting out their own directions.

John Lumsden : *This question might have also been directed at Tom but I didn't get that chance so I will ask it of Hans*. One of the difficulties I see with the Act *are statements like, "matters of national importance" and, as a*pplies in my area of interest, *the coastline, "preservat*ion of the natural environment". *Much of New Zealand is of course no* longer in its natural state and I'm curious to know how the R*egions would see this in terms of their own role. How do you deal with matters of national importance when perhaps it's a regional interest you are considering, and what actually is a matter of national importance?*

Hans Versteegh : Some of these are just purely statutory matters to sort out. As I said before, the Act has one goal and that is set out in Section 5. Subservient to that are matters of national importance and these things are to be seen as ancillary. The Regional Councils in the exercise of their duties will have to deal with these things as well. The only thing that one can hope is that there is no conflict. The whole 'motherhood and apple pie' thing is another issue. Previously I

think planners had the motherhood and apple pie statements stuck in their scheme as objectives, and basically this type of statement has now been put in the legislation where they manifest themselves as principles, overall goals and objectives. The difficulty we have in putting them into practice is that when we are scratching around looking for objectives, it's very hard to find yourself not just restating something that is already given; it's already in the legislation so we have to do it and have to work towards that end. Our problem is trying to define what our role is when confronting issues and what it is we are going to do; the motherhood and apple pie just stays back in the legislation where it belongs.

Jeff Jones : *We've just been talking about motherhood. Many of the forebears of the Regional Councils, things like pest destruction boards and catchment boards, believed in fatherhood or the sledge-hammer principle, which was 'trust us we know what we're doing'. Engineers like me, 25 years out of this place, found that very comfortable. We are now into a situation where we've got to find out what the community wants. Now the old system under the Water and Soil Conservation Act would stick an ad in the paper and wait for some response and, depending on the issue, you might have got 10 responses, you might have got 100, but in reality you only got 10 because 90 of them were all on the same piece of paper that somebody had photocopied and everybody had signed, saying the same thing. Would you like to comment on how you think we can get real community input and not just the perhaps polarised views of the two extremes in these issues which are very important issues, and which may be in conflict with the fatherhood principle of 'we know what's good for you'. I think that's very important, particularly in the Regional Council's role when we are dealing with issues that are a lot more theoretical than perhaps the districts are dealing with, say with the more immediate requirements of roads, rates and rubbish?*

Hans Versteegh : We've got a real attitude problem here and that attitude, I must admit, still persists and will persist for quite a considerable period of time, this whole fatherhood one. It's very hard to change attitudes and I guess when you're actually writing a Regional Policy Statement you find out just how hard it is to let some of these attitudes go. To get community input, I think it's a question of empowerment of communities so that they understand what it is that they can have input into, what the process is about, how the processes work and then empowerment in terms of knowledge about their environment. I think too often the real knowledge is actually confused or hidden or sat upon as the exercise of people's control of power over others and I think we've got to remove this power thing that exists between councils and the communities they serve.

The question of empowerment of course also means that there is a responsibility on the part of the people who are the father figures to empower themselves and learn something, and I see the consultation processes that we have set up as a learning exercise. I'm not a engineer, a geologist or scientist of any shape or form - everything that I have to translate into practice has to come from what somebody else can teach me and that includes community values, the standards that they seek, and it's a matter of being able to target the right questions. There is a tendency to write a report, send it out, get comments back; most people can't put a context on the report, they can't put a context on the questions that are asked and if they are used to making submissions to Government then they know that it's all a waste of time anyway. So there is this whole question of empowerment that I see needing to be focussed on. The programme that we have set up hopefully works towards that end - it won't be perfect and there will always be criticism.

Mr Mike Garland, Queenstown-Lakes District Council

"Sustainable Management - A District Council Viewpoint"

By way of introduction I am the District Planning Officer for the Queenstown-Lakes District Council. Until a little over a year ago I was a planner in private practice. I have worked in the planning area in New Zealand and in the United Kingdom for about 27 years now and I must say it is interesting to note that with the Resource Management Act we are seeing the first real sign that planning as taught in the 1960s might receive some implementation.

I have come to a local government unit at a most interesting time; for instance, reorganisation has brought things very much into line with the private sector with employment contracts and the like. Working in local government now has a much higher profile and I have had to become used to the idea of having to make many public addresses, speaking on the radio and to the local newspapers, who in our district are very hungry for anything controversial, and this seminar is just typical of the tasks I am called upon to do.

All local government units have an enormous task ahead coping with the requirements of the Resource Management Act. Its effect has been to increase very much the day-to-day office requirements and the monitoring work. The continuous nature of this has meant taking on more staff nearly everywhere, and this is especially so in Queenstown which has a very buoyant economy.

Hans seemed to be keen to assure you that planners have not been legislated out and that they still have plenty to do. I would go so far as to say that there is so much work in our district that some of our locals may have cause to think that the Resource Management Act (RMA) was a successfully orchestrated attempt by lawyers and planners to create more work. In some respects, Queenstown is in the mainstream, or maybe even a leader, but we are geographically remote and many of our past policies are reflected in the insularity caused by that. Most district planners have had very little opportunity to spend any length of time on the long-term ramifications of the RMA because of the tremendous burgeoning of immediate work it seems to have brought us. In that respect, I am always grateful for the receipt of information sheets from the Ministry for the Environment (MFE). The last that came out, Sheet No. 6, is directly on today's topic and my first chance to glance through that was on the aeroplane this morning. I must admit to some relief that the path we've taken does not really deviate markedly from that envisaged by the MFE, so I don't suspect we'll have too much trouble.

If I could turn now to the task that the RMA has set for the District Councils. The theme of this seminar is sustainable management and indeed it is very much the *raison d'etre* of the Resource Management Act itself. Tom Fookes has explained the relevant definitions from the Act and you will know something about what sustainable management means. Well, our Council must manage the use, development and protection of natural and physical resources (which in itself pretty well means everything - even structures) in a specific way. In particular, we must ensure that the reasonably foreseeable needs of future generations are sustained, the life supporting capacity of air, water, soil and ecosystems is safeguarded, and any adverse environmental effects are avoided, remedied or mitigated. We have to do all this while providing for the social, economic and cultural well-being and the health and safety of people.

The Council has several tools for carrying out this task, but basically they fall into two areas. Firstly, it can use its District Resource Management Plan (which is a replacement for our current district schemes and is linked with the Council's Annual Plan) to control, cajole, coerce or entice the developer to comply with the principles. The Resource Management Act 1991 deliberately refrains from prescribing the methodology we should use. All sorts of methods

seem possible although I expect military force would have be ruled out! The new Resource Management Plan is primarily my responsibility and to give you some perspective I will focus on areas in this field.

District Plans can deal only partially with sustainable management issues, but their role is crucial in achieving sustainable management. It is only through the Plan that rules can be developed and applied. Thus, they are the principle regulatory means by which sustainable management is to be achieved. However, the Plan is not intended to be simply the vehicle for the promulgation of rules; they must provide interpretation, reasoning, and in every way assist the Council to carry out the primary purpose of the Act.

Secondly, the District Councils can use other methods such as steering the spending of public money in a direction concomitant with the principles of sustainable management. It can carry out its own works with these principles in mind. I would expect such methods, or many of them, to be reflected in the Council's Corporate or Annual Plan.

I would like to turn now to the District Plan itself. Just as with our old district schemes, this plan is concerned with land use which also ironically includes water surface uses.

It was suggested to the organisers of this seminar that the Queenstown-Lakes District Council has some unique problems with sustainable management and its resources in coping with the demands of tourism. I think every district will have unique problems - none of them less than ours - we are not alone in that. We are perhaps unusual in that over 85% of our sustenance comes from tourism - we have no backup industry at all - and tourism relies on our clean environment and, above all, it relies on the unique landscape with which we are blessed. Of all our resources I believe the visual is the most important in terms of future opportunities to sustain our community and to provide for it to grow and prosper. The greatest difficulty we have is in understanding, monitoring, measuring and assessing the potential effect of human activities on the visual environment. It will be relatively easy to cope with water and air pollution because the techniques whereby standards can be set and effects monitored are already developed to a high degree. In Queenstown-Lakes we have much of this in place already. Whether we can measure our resources or not, we know they are finite in some way. The water in our rivers and lakes is continuously renewed and we know how to keep it clean, but how many rafters and jet boats can they accommodate before the resource is downgraded for other potential users?

Currently we are in the thick of dealing with numerous applications for water use. There is a high degree of innovativeness from applicants with every current user saying the resource is fully used. They seem to have the credentials to be experts, and somehow I know they're really not - they're trying to preserve the cake entirely for themselves. We've got a big problem in this area.

How many lifestyle subdivisions can our hills and terraces take before they start to be less effective as a draw for tourism? I am pretty sure that with bungy jumping we may have reached our maximum because there are not too many more bridges. In the last three bungy-jumping applications we have had, we have had to say that you can only have one bungy operation going at any particular time on one bridge; but if we didn't say that, we would quite easily find ten or twelve wanting to do it all at once. They seem to have plenty of money and it seems to create plenty of wealth. But with every one of these activities there are bound to be thresholds where mitigation measures should take place, or beyond which we should not travel in the interests of sustainability. It is this whole area of understanding how much of a resource we should leave for private people to use and how much we should divide up between the operators before the resources are actually irreparably damaged or it simply becomes not a resource any more.

I believe the way we have chosen to tackle this is much the same as most Councils. We have identified the major resources and embarked upon a series of resource studies so that we may

better understand the extent and capacity of each one. Some Councils adopt scoping reports with public discussion documents, and others merely produce discussion documents and have meetings. We use a mixture of techniques to engender public response. I don't think we have consciously developed those techniques, they've been developed as we go. We were lucky in having a cooperative press and our town centre study, for instance, was taken up by a local newspaper which undertook to send a copy of that issue to every single person on the rating roll - all for nothing. So we are getting very good public feedback as a result of really quite successful public participation.

The first of the studies we commissioned dealt with the landscape resource in the Wakatipu Basin. That's the area that most of you will know round Queenstown - Frankton Arm, the Kawarau River, the Shotover River and Arrowtown, through to Gibbstown where the new winery is. That was developed by consultants who carried out a public participation exercise in determining people's perceptions of the various elements of the visual environment; we've just gone through the in-house exercise of extending that study into the Makarora area and are about to go public with the local community. I mentioned before we are completing a study of the town centre resource, much of which is visual, but of course a lot of it involves traffic circulation and other factors. Transport infrastructure, soil stability and many, many others need to be taken into account. These studies and the recorded public response are going to form a bank of information from which we can build our new Resource Management Plan and my own Council is really eager to get on with that Plan. They have asked me how long it would take to do in-house with all the studies being done by consultants and I have told them a minimum of three years. That's not good enough they all say, it all has to be done in eighteen months, give us a price to do it in eighteen months. So I must say that now I am after another quarter of a million dollars, and I hope that the councillors and the public will see that what we are doing is making the cake bigger, creating more wealth and enabling more people to live in comfort in the district.

All of these studies must be carried out in terms of a brief, taking into account the principles of regulation expressed in the RMA. The Act intends that any landowner or developer should be able to do as he or she wishes except where there would be an adverse environmental effect, in which case there would be a rule, a prohibition or an economic instrument in the Resource Management Plan. The Act's focus on end results is intended to encourage the adoption of performance standards, which are seen in some way to be an alternative to the present zoning techniques, the lists of permitted uses and the bulk and location controls. This, I might add, comes after fifteen years of intensive investigation of performance standards by some Councils, many of which have found such techniques to be rather wanting.

To me, all this means that there could, and perhaps should, be a whole new way of doing things. We will not be able to make lace out of old rope for instance by patching up District Schemes and turning them in Resource Management Plans, a sort of 'nip and tuck' approach if you like. I don't believe that is in any way a practicable proposition. The Councils would have to justify the retention of the old controls and concepts, just as they would with new ones, to show they have considered alternatives and that the chosen method is the best in environmental terms. Actions have to be fully justified and before adopting a new policy, rule or method, a Council must have regard to five principles and I'll go through these.

Firstly, is the principle of necessity - we have to show that any policy or rule is necessary to achieve the purpose of the Act; that is, sustainable management of resources.

Secondly, there is the principle of alternatives - there is a duty to examine alternative methods, including economic instruments, incentives, and so on. Obviously there could be various carrots and sticks ranging from rate rebates to various penalties. And perhaps as I said, no military action. We will have to examine some of these on a competitive basis.

Thirdly, we have the principle of explicit reasoning - this requires the examination of the reasons for and against the proposed method as against the other alternatives.

Fourthly, the principle of assessing costs and benefits - this requires a study to carry out an assessment of the likely monetary and non-monetary costs and benefits of the proposal and its alternatives, including the 'do nothing' option.

Finally, we have the principle of efficiency - the proposal has to be shown to be the most efficient and effective means of exercising the function.

Of course all this means that our new District Plans are likely to be rather different documents. We might abandon zoning, though I expect not fully. Disruptive elements will be controlled or eliminated by very high performance standards which may be administered in measurable, assessable form or which in the case of visual elements may have to be judged very carefully one by one, paying reference to principles expressed in the plan. Industrial and commercial activities will be allowed with greater freedom in land-use terms, but again with very strict environmental standards to protect residential community or landscape amenity.

Large non-rural activities may be able to locate in rural areas provided their measurable or assessable effects are acceptable. Yard setbacks and specific height controls may disappear and be replaced by other means of assessing performance. There will be problems because, even with measurable effects, I expect you will realise a developer will not be certain whether the required standard can be met until the project is running. Too late we'll discover that an operator cannot meet the required performance level. With any large project a 'shut down' may not be politically acceptable and we may have to entertain exceptions after the event. The performance standard approach will have a severe effect on some developments but it will mean that the true cost of development is borne by the developer rather than being subsidised by granting free detractions from the publicly owned environment, as so often happens at present. It reflects a 'user pays' philosophy if you like, where the person proposing change is the user of the environmental resource.

If I can turn now to the other methods that the Council may use. It must be remembered that although the District Plan will be the most obvious element of the District Council's arsenal, it is only one part of it. The District Plan has to fit within the District Council's corporate planning process. Now that all Councils have reorganised themselves to that, the planning and regulatory functions are no longer under the same second-level management as operations and services, it is more important to understand this context. For this reason the District Plan and its components cannot be developed in isolation, and the Annual Plan, and indeed all the Council's policies, can be directed toward the objective of sustainable management.

A local authority must research a wide range of social, economic, health and infrastructural issues in order to determine where to spend its income from rates and other sources. The Annual Plan is the vehicle setting down the results or outputs to be achieved in the coming year. It is also the means of making the process available for public scrutiny and accountability.

It is essential to look beyond the one-year horizon, however, and it is also for the Annual Plan to formalise the longer-term goals into which the detailed yearly outputs fit. This longer term focus integrates with the Resource Management Plan. To put it more succinctly, the District Plan must ensure that in pursuing the broader corporate objectives no conflict is engendered with the principles of sustainable and environmental management. Adverse effects have to be avoided, remedied or mitigated. Thus the methodology for the Annual Plans and District Plans has to go hand in hand.

It seems facile really doesn't it? All we have to do in each action we take is to ensure that resources are not consumed or affected beyond the point where our descendants are likely to

find they would not have the potential to meet their needs. It will require judgement and clear reasoning to enable us to ensure that future generations have the capacity to support themselves. We have to be able to decide what environmental state represents the appropriate level for sustainable management in each case.

In fact, I believe it is a task of some enormity that we face in District Councils, and it will be beyond even the largest of us to complete without outside help. We are enlisting this particularly in the resource study area and have engaged several consultants already.

Before I close I'd like to make one final comment. Many of you will know something about the current District Schemes. Imagine if you can what a task it will be to make the new document simpler, shorter and more easily understood. I for one will be trying to do this despite the obvious and considerable forces which will try to drag me in the opposite direction.

DISCUSSION

Fiona Norton (Royds Garden, Christchurch) : *The new Act assumes that, or rather is based on, the assumption that environmental effects can be measured in advance and that's going to be quite difficult in some areas. Do you envisage that, in fact, there's going to be less certainty for developers or applicants and possibly the need for a lot more applications to be assessed at the time?*

Mike Garland : Yes I do.

Fiona Norton : *And how is that going to go down?*

Mike Garland : I think that the public has been led to believe that this legislation is going to mean fewer applications. In fact it's not going to do that at all. In our area we will be required to pay particular attention to the visual resource, which we have not done in the past. I don't see how we can set down performance standards for the colour of a particular house in a particular location, or its architectural style. Each one is going to have to be considered on its merits and what's more with a ten-day turnaround.

Fiona Norton : *The next problem then is that most Councils wouldn't have those skills and how else would you expect people to have had some in-house training? I can see that's where it's going to be a real problem in actually implementing it.*

Mike Garland : Yes, there will be a problem largely because of the ten-day turnaround. We won't actually have time to go out and get a consultant to get the turnaround within the ten days. So yes, there will be a problem and I expect it will mean that in our area we may have to have more people on my staff to deal with these, or we may have to set up a standing committee involving some professionals in the area. We haven't quite got to grips with that. But we are talking about it.

Fiona Norton : *Visual is the obvious one - are there any others?*

Mike Garland : Visual is about 80% of everything that matters; we are unique in that respect. But, yes, there are lots of others.

Brian Knowles : (Royds Garden, Palmerston North) *Having compared notes with Fiona, perhaps there are a couple more names we could put on this hit list, maybe the accountant and the planners from my early experience with these specific consent applications. A question for Mike and Hans in relation to mastering the fourth schedule. We are finding it pretty demanding at the early stage of a project and pretty much concerned to the applicant's accountant at this front end. This is our early indication of the Act, particularly in the smaller and medium private projects; the bigger local authority projects exercise could be pretty well - expected and there's going to be a big front end; but with early indications there is a significant problem in the education of the applicant in relation to the demands that have to be put in to the planners to satisfy them. In other ways you need more staff. In the North Island, where we are operating, our way around that it is to keep asking the applicant for more information until they think they are satisfied.*

Mike Garland : There never was the concept of consent in principle, although a lot of people were allowed to operate on that basis, but that's certainly gone out the window now. Any applicant is required to have a good handle on the almost precise effect his development will have on the environment before he even makes the application and that is proving very, very tough for people with few resources. I must say that I am having to mollycoddle a lot of people through the process and that's pretty difficult; we've had about 120 notified applications since the first of October, which is about twice the rate of Dunedin City I think, and we are just having to take extra time to help people gather this information. They can't really find the resources even in Queenstown; they have to go to Dunedin or Invercargill to get people with the right qualifications to assess something and that alone might mean the proposal can't go ahead. So yes, we are having difficulty with that.

Hans Versteegh : I'll comment briefly. The Act will put pressure on Councils not to go down this route; they will be looking at other methods and solutions to problems other than regulation, setting up resource consent procedures. I think you will find the cost of running a resource consent procedure generally exceeds the benefit of it.

Tom Fookes : *More a comment than a question, and it's really a case of picking up where you left off, Mike, about the point at which somebody walks through the door and lodges an application. I think in answer to the last question, Councils are able to do more perhaps than they have in the past to make it quite clear to people out there who are in the category of developers, and that's just the ordinary person out in the street who wants to do something, to come to the Council and talk about what it is that they are thinking about doing well before they get to the stage of wanting to put in an application. In other words, there is an opportunity for exploring some of these things before the clock starts ticking. For heavens sakes, start talking to the regulatory authorities well before you actually lodge your application - that principle applies right across the board now. Councils may need to put out information and explain to their residents that they should explore some of these implications before they actually get to the stage where they are running on tight time lines themselves because of commitments and options on properties and things like that.*

Malcom Douglass, Director of Planning, Porirua City Council

"Sustainable Management of the Built Environment"

Introduction

At first glance the Resource Management Act (RMA) appears to have greatest emphasis on the "natural and physical environment" (that is, land, air, coastline), and almost overlooks the social, economic and built environment. This is not the situation and the built environment is included, but with a different emphasis than in the Town and Country Planning Act 1977.

The Town and Country Planning Act was primarily a code for community design regulating the location of land uses, but with an emphasis on co-ordination of public input and a standardisation of private development patterns.

The Town and Country Planning Act has enabled many policies and good practices to become well-established and accepted - especially recognition of the groupings of compatible uses.

In terms of the built environment of our cities and towns, which accommodate 85% of our living and working locations, the Town and Country Planning Act was specific over a wide range of issues. The RMA is silent on most design and planning for urban development issues except when it conflicts with:

> "Sustainable management or environmental quality."

Environmental qualities are to be measured and monitored - from here we enter uncharted waters. The number of variables that can be measured are few and environmental quality may have deteriorated a long way - for example in terms of noise, air pollution, traffic congestion, visual pollution - before that difference in quality can be measured.

Nevertheless the RMA is a change of emphasis that was overdue - it is a step further toward 'prevention' rather than 'cure' and seeks a genuine inquiry into 'effects' rather than 'prescriptive design'. In the built environment the RMA may encourage a more inquiring approach to performance standards and targeted controls.

Sections of the Act Relevant to the Built Environment

The Act does not explicitly refer to the 'built environment'. There are, however, numerous references to the physical environment, to structures, to the efficient use of resources, and references to communities and their needs.

The purpose of the Act (Section 5) refers to the promotion of the sustainable management of natural and physical resources. National Policy Statements may be developed to state policies on matters relating to the built environment (Section 45 (2)(a) and (c)), while Regional Policy Statements and Plans are concerned with, amongst other things, physical resources and the needs of communities (Section 59 and Part I Second Schedule). District Plans have similar concerns (Section 75 and Part II Second Schedule) and are concerned with the effects of specific activities on the environment.

Restrictions on the use of land (Section 9) also cover the management and control of the built environment. Within Section 9 'use' is defined as: "...any use, erection, reconstruction, placement, alteration, extension, removal, or demolition of any structure or part of any structure in, on, under, or over the land" (Section 9 (4)(a)), and 'structure' is defined as:

"...any building, equipment, device or other facility made by people and which is fixed to land" (definitions).

The Act provides for rules to state permitted, controlled, discretionary, non-complying, and prohibited activities (Section 76 (3)), having regard in developing such rules for the likely effects of the activities on the environment (Section 76 (3)).

The category 'non-complying activity' clearly indicates the emphasis of the Act on effects, a non-complying activity being any activity which contravenes the plan but is not prohibited (definitions). This category of activity highlights the need for controls to be directly related to effects, and the opportunity is there for designers, engineers, surveyors and other professionals involved in development to come up with proposals which meet the necessary environmental standards anywhere in the district where the activity is not expressly prohibited.

The Built Environment as a Resource

The RMA is concerned with the sustainable management of natural and physical resources and the mitigation of adverse effects on the environment.

In the context of our cities, the buildings and residential resources are a particularly significant resource, having direct daily relevance for all of the city's residents. This resource cannot be readily or quickly replaced or upgraded if mismanaged. The District Plan will define the built environment (under Section 75) as a significant resource management issue.

This leads to the need to understand what sustainable management means in the context of urban fabric and the built environment. It is concerned with the continued use of the present commercial and industrial buildings and housing stock to meet the projected demands. It is also concerned with promoting the development of additional buildings in a way, and at a rate or at locations, which have the least detrimental effects or, stated another way, the greatest environmental advantage. The same principles will apply to public utilities, networks and new public facilities such as roads.

In general terms, no new transport facility can be expected to 'get off the ground' unless there are environmental and community benefits accruing from the proposal that are clearly advantageous, readily identified and widely accepted. The fact that the proposal may be economic in the sense of costs and benefits is no longer proving sufficient to permit some proposal decisions to be made to proceed.

Meeting the Obligations of the Resource Management Act

The Act creates two major requirements for District Planning Policy:

(1) That policies are clearly and robustly justified; and,
(2) That the effect of that policy is able to be, and is, monitored.

In response to these requirements Councils must develop a database on the built environment resource, both for the purposes of identifying issues which merit some form of management and to ensure that, when policies, objectives and rules are developed, their feasibility can be readily tested and their effectiveness monitored.

Such data must be collected and transferred from hard copy (such as registers and files) to tables and maps, which can be easily transposed for use in a Geographical Information System (GIS) and for future monitoring purposes.

As a result, data collection will form a major component of the urban as well as the non-urban planning process. This is justified when it is considered that any person or body can object during the planning process to an issue, policy, objective or rule on the grounds that the need for it or the method adopted has not been adequately justified.

The issues of sustainability in the built environment relate to the location, layout and quality of construction and services. It relates also to conservation practices and the geographic distribution of activities.

We are building on to what we have and, in twenty years, nine-tenths of the urban fabric will be our present city. Physically our cities are strongly built. Issues of conservation of energy and policies of sustainability must be looked at in the context of what we have.

Development Control

The RMA is concerned with the promotion of the "sustainable management of natural and physical resources" and "environmental qualities". In achieving these aims through the District Plan process Local Authorities may include rules which prohibit, regulate or allow activities (Section 76). In making such rules regard shall be given to the "actual or potential effect on the environment of activities". Rules may apply throughout a district or a part of a district and different provisions may be made for "different parts of the district" or "different classes of effects arising from an activity".

There are two factors involved in developing rules for inclusion in a District Plan. The first is identifying what resources should be sustained, and the second is to identify what 'effects' need to be controlled in, say, the city centre of a residential area. It will then be possible to identify what performance standards are needed to ensure that the potential or actual effects of activities are appropriate in the urban and suburban areas.

The challenge is to define performance standards which thus enables activities to be classed as:

- permitted activities;
- discretionary activities;
- non-complying activities;
- prohibited activities; or,
- controlled activities;

and enable the early identification of the performance standards to be met and the information to be supplied by developers.

The RMA has brought together these issues so that resource consents can be required for:

- activities;
- buildings;
- earthworks;
- public utilities and networks (including roading);
- subdivisions;
- water rights;
- discharge permits;
- hazardous substances;
- coastal activities;
- heritage orders;
- pollution;
- Maori interests.

In addition, the Building Act requires consents to the construction within each site and its safety and services.

The Building Act

Part of the reforms complementing the RMA are the resource consent processes for new buildings. The thrust of the building reforms can be contrasted as shown in Table 1.

These changes from the past to the future lead to a major rethink in the traditional role of Local Government in the whole area of building control. A new management style is required and different criteria, clearer logic and a higher throughput for less expenditure will apply.

Significant Residential Effects

It appears that in the residential area there are three types of effects which need to be considered:

- Those which affect the 'amenity' of an area (for example noise, sunlight, privacy and views)
- Those that affect the 'character' of an area (for example the scale of activity, the appearance of the buildings or area). This type can be controlled by conventional bulk and location controls and design standards.
- The 'natural/ecological effects' which go beyond the compatibility of the activity with other local activities and relate more to the wider cumulative effect on land, water and air.

In essence the approach embodied in the RMA is not dissimilar to the intuitive design objectives already in place in District Schemes. Greater emphasis is placed on assessing and recording environmental impacts and more freedom is given to allow any activities which meet the design code or performance standard. The decision to set a certain level of performance is based on an understanding of what environmental and social impacts are likely and what effects or level of effects are considered acceptable.

Housing Policy Provisional Analysis

It is found on analysis of demographic factors, economic factors, density and house types that there are differences between residential areas which are socio-economically led and spatially expressed. However, these variations do not appear to be related to physical circumstances (house age or density) or to local services (recreation reserves, shopping centres) or any other measurable factor in physical terms. An analysis of the planning applications over the past five years confirms that different population make-ups may have different residential needs. This is not only in terms of the type and cost of housing but also in the services provided in the immediate area and expectations as to the landscape and visual environment.

We can conclude, however, that:

(i) There are not sufficient differences across all areas to warrant differences in basic bulk and location standards affecting daylight/sunlight or open space/living area, nor in general for other 'amenity' standards such as noise, density, or other factors affecting environmental, health-related aspects. Hence, common performance standards can be

Table 1 : Building Reforms - Past Practices and the Future Situation

Past Practices	Future Situation
Prescriptive-based Code	Performance-based Code
Construction to Uniform Standard	Construction to Meet Occupation and Risk
Policy and Regulation together	Separation of Functions
Individual LA Standards	Centralised National Building Standards
No Appeal Authority	Building Industry Authority for Appeals
General Oversight by TAs	Responsibilities defined and divided between TA and Owner
Statutory Limitations Vague	Statutory Limitations and Liability Clearer
Design Checking by TA only	Private Certification or TA
General Inspection by TA	Inspections by both TA and Certified Consultants
Building Permits	Project Information, Memorandum, Building Consents, Compliance Certificates, Building Warrants of Fitness annually, Change of Use Notices, Land Information Memorandum
General Practice Inspectors Plumbing	More Specialised Inspectors over a wider and Building field (including Electrical, Fire Safety, Lifts, Ventilation etc.)
Minimum Fee Rates	User Pays Charges for processing and consents
Several Land Information Files	Single Land Information File
Hard Copy and Envelope Files	GIS-based Computer Files readily accessed
Separate Approvals	Co-ordinated Approval of all aspects by TA
Annual License Inspection by TA	Owners responsibility to meet Schedule of Compliance

LA - Local Authority; TA - Territorial Authority

established which best measure the way any residential use 'looks' (bulk and location, design, scale) and 'acts' (traffic-generated noise, other emissions, pattern of use - for example, whether occupied at night and during the day) for all residential areas.

(ii) There are servicing differences which may result in different standards for residential areas. These factors would include the impact of activities on the road capacity, water and sewerage capacity, slope and topography.

(iii) While there may be differences associated with different population characteristics (for example the elderly - smaller units; ethnicity - need for churches) there is no reason why just because the demand may be concentrated, there should be different standards across the residential area. These factors may best be dealt with by a subset of rules or performance standards applied at the site level on demand from the market as discretionary uses.

(iv) There may need to be different standards at the interface of the residential area with other activities.

The visual differences between housing groups relate to owner attitude and a market of willing buyers and sellers as much as to planning controls. It is likely that there will be different zones, but this will be based on the need to encourage the best utilisation of resources, not as a response to perceived differences in socio-economic or single- versus multiple-unit conditions. The 'environmental bottom line' will be common across all areas. However, the Council may consider it relevant in response to 'social needs' rather than 'land/resource-based limits' as to whether or not there are advantages in lowering the bottom line. This would allow more activities in some residential areas where this may meet other needs, for example policies flexible enough to accommodate home occupations or multiple units in what were previously single-unit homogeneous suburbs.

Centre City Buildings

In the complex built environment of the city centre, where valuation patterns and conventional real estate trends will continue to reinforce the established investments, the RMA is not explicit as to the restraints and issues to be addressed.

The Act does put in place the process requiring identification of significant resource management issues, assessment of effects and the establishing of rules, but does not foreshadow the outcomes.

This is correct in logic. The RMA requires the planning process to be undertaken - it cannot and should not prescribe the objectives to be pursued nor the design practices to be followed.

Thus in the central urban built environment the role of the Councils as planning authorities, the designers as creative interpreters of the significant resource issues, and developers as initiators remain, as previously, an active area of proposal and negotiation.

Objectives, Rules and Environmental Assessment

Given that a Council has established some objectives and policies for the urban built environment, leading to rules included in an approved District Plan, there will be some guidance to developers. However the new element is the "Assessment of Effects on the Environment Report" (Fourth Schedule). It is in setting the issues to be included in this assessment that both the Council's planners and the developer's consultants will need to be clear and complete in their

approach. The application for Resource Consent must be accompanied by this assessment. The application and assessment are, of course, both made available to neighbours and the public prior to any resource consent hearing or determination.

The decision as to whether a proposed activity is advertised or not rests with the Council in the light of the contents of the District Plan and its interpretation of the nature of the proposal.

Resource Management Act in Perspective

The RMA takes us into the third phase of building control for cities since the 1950s. It began with a strong safety and building bylaw emphasis that was overtaken by structural technology in steel and concrete. This was followed by a strong civic design and community architectural approach in the 1960s. This was outgrown by the variety and technical ingenuity of designers in the 1970s and 1980s.

With the RMA, communities will need to reappraise the key issues of light, shadow, views, services and the like, and establish new objectives to be pursued and tested with new building development.

Most importantly, the Act is only one tool among many. The Council's Corporate and Annual Plan is of equal importance - how the Council arranges its own programmes of utility services, public buildings, parks and open spaces is of equal importance. The arrangement of access transport systems, parking management and new parking areas are a third dimension in the process of City Centre redevelopment.

Conclusion

There is much work to be done in re-thinking policies for the built environment under the RMA. The Act does not provide guidance in this area and assumes it can be handled in the same manner as other physical and natural resource management issues. Much freedom is left to Councils and designers to hammer out practices and rules acceptable to the community and defensible in law.

The Transition Plans from the past only have a limited life, and up to five years are available to establish new objectives and rules for the built environment. Public utility designations only last until 1 October 1993.

Many aspects of the built environment will be the subject of initiatives in the Corporate and Annual Plans of Councils. Councils can no longer rely on the reactive role of the District Scheme to guide all aspects. Rather, a pro-active role on investment in infrastructure and negotiation of issues to be addressed by developers will both be of greater significance.

The volunteering of Environmental Assessment Reports as part of Resource Consents should be a valuable tool in approval of major future development proposals.

DISCUSSION

Roger Dunn : *I wanted to ask Malcolm about one of the concerns that I have, and you did raise it as did one or two other speakers; you talked about the measurability of effects. You and I both come from the traffic and transport area, which we can tell everyone else about*

without too much problem; we have a development going on along the road and the first house or the first thing is not problem, but eventually it reaches a point where it is ribbon development. I don't want to drag out the discussions, but how can we deal with those things? Personally, I am very unclear.

Malcolm Douglass : You certainly can't deal with it on a consent-by-consent basis. Obviously in the consent-by consent-basis it would be incremental growth in which you would at the end not be able to say no to the 51st application and all the rest up to 100% congestion. So it's got to be established very clearly in the objectives to the scheme. The second point is that while you may establish a rule for contributions to improving the road, or a rule for levies or other matters or conditions for the development, which is based on the whole 100 units being in place and that's necessary to do that task, in order to decide what the rule is for number 1, 2, 3, 4 and so on, you do have to go through that planning process, which is no different to the feasibility studies and so on done in the past, or what the global effect of that development would be. So I think that in this context the need for growth studies, the need for complete appraisal of density implications and so on in planning areas of your district or region still apply, but you are using it for a different purpose. You are using it now not so much as a blue print masterplan for way out there, but a way to come back and control the incremental changes that the market brings to you as you go along.

Derry Gordon : *Malcolm, I wanted to come back to something which has been mentioned two or three times this morning in the area of public participation. It seems to me important in the area of the built environment because that is where most of us live and work. It's the environment that really matters most to us, and I think on analysis that's where most of the RMA functions are really going to bite, as it were. Two things I was wanting to ask. Do you see anything in the RMA which is actually going to make public participation more likely? Is there anything in there in the way of carrots to encourage planners and others to make this an issue, and secondly, do you see it as being any different from what it was under the Town and Country Planning Act?*

Malcom Douglass : In terms of serving the needs of our clients the whole area of the external relationships between councils and public authorities and the public has altered dramatically in the last three years. I think most councils either have or are about to be involved in citizen surveys which are even-handed statistical surveys of attitudes towards Council and towards the works and services provided. The Annual Plan provisions in my mind are more important than the Resource Management Act as to what finally happens because if Councils are not prepared to put the resources into the public participation in dollar terms we certainly won't have the time and the energy to do it in Resource Management Act terms.

I am caught in the horns of a dilemma. I mentioned three years. Public participation can increase the cost of this work probably two times, maybe more. I don't know. We all want it. If you go out with a clean sheet of paper, it will take another three years on top of the three years. The horns of the dilemma I'm in as a professional is how much distillation of the issues do we do before we start the participation process, and that, I think, is enough of a problem.

Just how clear are we on the options, or do we dispose of matters which are unreal before we start the discussion - because as soon as you do that you've made an arrogant professional decision. You may be meeting the broader community's view that they want the job done in three years, so I think this is a bicycle ride we all take at great risk, but my personal view is that I prefer to go out with draft material I can explain and substantiate rather than going out with a clean sheet of paper. My process is the process normally used to get a community owning a plan.

SUSTAINABLE MANAGEMENT OF CATCHMENTS

Urban River Study - Heathcote River

Waimakariri Flood Plain

Upper Kaituna Scheme Works

Dr Judith Roper-Lindsay, Boffa Miskell Partners Ltd

"Urban River Study, Heathcote River"

I would like to thank the organisers for inviting me here today. I am sorry I have been unable to be here this morning and pick up everybody else's definitions of sustainable management - you are going to get another definition this afternoon. I think it is particularly valuable for me to be here because the Resource Management Act means to me that a much wider range of people have to be involved in this exercise called planning than had to be involved, or were even interested in being involved, when it was Town and Country Planning, and Soil and Water Conservation.

The Resource Management Act is about making connections between areas and between subjects, and I think it is very much to do with connecting people of various areas of expertise.

So I am going to talk for ten minutes about my view as an ecologist of what sustainable management means and use as an example the Heathcote River Study, about which some of you - the local people - will know a great deal, I hope.

Generally, my background is as an ecologist who spent the best part of five years crawling around on hands and knees in the north of Scotland looking at plants. Then I stood up and walked and came to New Zealand! I worked with the Ministry of Works for seven or eight years here, so I think that gives me some background in how to understand at least some engineers. Now I am in private practice working with a wide range of people with planning and engineering backgrounds, landscape design, and so on. So I guess that over the last few years I have been putting into practice this 'sustainable management' that was actually put into legislation on October 1st.

To me sustainable management is simply using a resource (in this case a river) in a way which doesn't actually have an *adverse* affect on either its natural characteristics or its natural processes. So that's the bits that make it up, the banks, the species, the water. The processes are the flow patterns, the migration route of fish moving upstream, the wider catchment values.

So sustainable management to me means making the river healthier - we have a poor record in New Zealand of river health. It also means that we don't have any fixed point where we say we have reached a *point of sustainable management*. We know very well when we have reached *unsustainability* or *non-sustainability* when species die or disappear, or when river banks collapse or rivers dry up, but the alternative is not so obvious. We can only take small steps along this path to sustainable management and feel a 'rosy glow' about doing that.

This approach of looking towards improving river health was the basis of the work done by the team of people on the Heathcote River. There were a wide range of disciplines, and a team approach to river management. The Heathcote study was a lot of interconnected pieces of work.

The simple background to the Heathcote River for those who don't know it, is that it's an urban river flowing through Christchurch. Before Europeans arrived here it would have been a slow-flowing, meandering river, probably with many branches and forks through a wetland, a swampland that was much of Christchurch in those days. Its catchment was forested and tussock grassland covered the Port Hills and the wider wetlands of the plains. Because of this background it had rich alluvial soils and a rich variety of plant life. It was teeming with fish and birds, as we were told by the early English settlers who came here and who shot and ate the birds. It was very different from the river we see today.

So in the last 150 years we've changed the natural character, we've changed the natural processes, and a whole range of interconnected things that happened (see Figure 1) - the general spread of the urban area, of chopping down forest vegetation on the hills, and replacing it with a thin grass cover that the sheep can eat. We've lost the diversity of plants that would have been on the river banks and through that and all these other factors we've started to decrease the water quality. I think it probably reached rock bottom at the height of the industrial era. Along the riverbanks the situation has improved in the last ten years. Loss of vegetation cover and increased stormwater flow have added to the silt load on the river. We had to have a programme of dredging to get the silt out and we have a heavy maintenance regime on the banks of the river - the grass is mown regularly, the trees are chopped and cut and cleaned, the river is dredged for the water weeds.

Figure 1: **Interconnected changes occuring on the Heathcote River over 150 years of settlement.**

- *modification of natural characteristics and processes*
- *urbanisation and intensive land-use spread through catchment*
- *loss of vegetation on hills*
- *loss of plant diversity on banks*
- *decrease in water quality (slight increase recently)*
- *siltation*
- *dredging*
- *planting, mowing and maintenance of banks*
- *changes in run-off quantity and quality*
- *changes in flood patterns*

[Note that most of these could apply to any lowland river in New Zealand]

It's not quite the rich diverse environment of 150 years ago and these sort of things I am sure you can all identify having happened to a river in your own locality. The major change which took place recently was the construction of the Woolston Cut .This was effectively to short-cut a meander which had been causing back-ponding and flooding problems. We were trying to protect the assets that had been built in the flood plain over the last 150 years and trying to get the floodwaters to the sea. A slight miscalculation - if you let the floodwater out to the sea quickly you also let the tide up quickly. In fact you let it get further up by the distance you've cut. Hindsight is wonderful!

The result of this saltwater movement were two visible symptoms. The banks collapsed. Huge sections of bank simply fell into the river taking with them trees, sections of road and the odd sewer pipe. Nothing too major, no major spills or anything, but threats to services. There is a road on both banks, in the new 'saltwater zone'. And the willow trees died. Being Christchurch, that was a major disaster. This is where the social pressure came to start doing something.

At the same time as this was happening and coming to a focus, the Local Government Act was changing structures. A new Drainage and Waste Management Unit within the City Council was formed, and part of their new look was a new approach. The new approach was to say: "Stop treating rivers as drains; it's a river system, it's got plants, it's got animals, and it's got a whole set of complex processes". There were problems that were hangovers from pre-cut days. The consultant team brought together lots of people, held public consultations and meetings, very much a multi-disciplinary approach to the problem, with engineers, landscape architects, planners, members of the public, members of the local community boards. There were studies,

and volumes of reports, and the outcome of the studies and talking to each other was that we made three main conclusions.

In scientific terms we realised that the saltwater penetrating the soil had actually been causing sodium-calcium exchange and was simply destroying the clays that were holding the banks together in the first place. On top of that, the sodium chloride was killing the trees by preventing them taking up water; and the third point was that the mud crabs (which like the saltwater/freshwater boundary) had all moved upstream with the boundary. Since mudcrabs make tunnels, they permeate the banks with tunnels, and not surprisingly sections fall off the banks. The tunnels obviously also increase the surface area for the salt penetration.

We believe that this is a synergistic effect; that working together the effect of these factors was greater than the effect of each on its own.

One interpretation was that what was happening was a natural process. The natural process of forming an estuary, which usually takes place over hundreds and even thousands of years, with the associated change from a rich soil into a silty, depleted clay soil. There is a natural process, too, of trying to even out the slopes, and most estuaries have very gradual bank slopes. Simply, the Heathcote River was trying to expand its estuary - a nice ecological solution that appealed to me. Perhaps we should let it happen, it's just a part of a total pattern of the Christchurch landscape?

The social impact assessment told us otherwise - that the people who lived beside a river did not want an estuary; did not want to live on the banks of a *smelly* estuary. They also wanted a road and they wanted the willow trees back. People are voters, people have political 'clout' and that has been the very strong message we have had to take back to the Drainage and Waste Management Unit.

To come up with a practical solution to the problem, the consultant's team put all the information together and created a set of environmental criteria. Then we said to the engineers, who had to design something to meet these environmental criteria, that we believed we must be able to grow willows or similar introduced trees along most of the banks (or that there should be some areas where we can use salt-tolerant natives). To do that we must lower the salt levels at certain points.

The engineers came up with a number of solutions that could meet those environmental criteria. The solution that's been taken forward is to put tidal flood control gates onto the newly constructed cut. These gates will open in flood; under normal conditions the river will follow the old meander.

This is the best environmental outcome as far as we are concerned. It returns the river flows to the old pattern and it allows the normal river processes to take place. But we must remember it isn't returning the whole river ecosystem to its former pattern - it's too late for that. A number of species have become extinct in that reach of the river simply because they couldn't live with the salt that went through. There have been a number of changes over the six years that the cut has been operating simply because of other things that are happening on the river, such as increased urbanisation, pollution from other parts of the river system and from agricultural areas upstream, increased stormwater flow, and management regimes which constantly chop away the riverbanks and dredge the bottom to the extent that some plants have disappeared.

So while we are restoring some of the physical characteristics of the river we can't put the clock back on the whole river system. But we *are* going to get a healthier river and a river that can continue to change in a much more natural way - what we feel is a *sustainable* river in the future.

The other important thing which is coming out of this problem is a landscape enhancement plan. This is a way of saying we've now got a vision of the river for the future. We know what we want it to look like and we can measure changes against that.

I guess that my conclusions for you are that rivers and even very small waterways are very complex biological as well as physical and engineering structures; and that we have a dreadful history of having modified these, particularly the lowland rivers of New Zealand. From an ecological/nature conservation position we can't afford to go on doing that any more. We have the technology and the ecological expertise to actually avoid degrading them further and I think there are people who really have both a need and a mandate to be brought together to do this work together.

Bob Reid, Canterbury Regional Council

"Waimakariri Flood Plain"

In her paper, Judith made a comment that rivers are not a problem. People and their assets create the problem. Very true. In fact, just to demonstrate that nothing in this world is new, and that the problems we are talking about are not new, in the study on the Waimakariri Floodplain Management Plan, there is a quote in the front of the draft report from Edward Gibbon's *The History, The Decline and Fall of the Roman Empire* in 1788.

> "*From a situation Rome is exposed to the danger of frequent inundations when the ordinary bed of the Tiber is inadequate to the weight of waters*."

It goes on to say that:

> "*The remedy at last was produced by the evil itself*...(I presume the evil here is nature)...*the accumulation of rubbish and earth washed down from hills is supposed to have elevated the plain of Rome 14 or 15 feet perhaps above the ancient level and the modern city is less accessible to the attacks of the river*."

That is, effectively, the problems we are trying to deal with.

In the case of the Waimakariri, the city of Christchurch is built on the flood plain of the river. The Waimakariri River, if left uncontrolled, would sooner or later switch course, without warning or difficulty, and would again flow through Christchurch and Kaiapoi. Both the risk of this calamity and the potential damage can be reduced by maintaining and extending the existing flood protection system, by implementing further protection measures, and by increasing investment in flood protection in step with community growth. The Waimakariri River Floodplain Management Plan has been prepared on this basis. The Plan aims to minimise potential damage to the Christchurch and Kaiapoi communities for a 30 year period (1992 to 2022).

The flood hazard posed by the Waimakariri is easily the largest in New Zealand. In the lower reaches the river is flanked on either side by a stopbank. The level of the bed and adjacent country is the same. During a major flood the river could erode a section of stopbank and break out to re-occupy old courses which reach down through city and town to the sea.

As part of the study we prepared a map showing potential flooding of the urban area of Christchurch City and Kaiapoi. The darker the colour the deeper and more probable the flow of water. A second map identifying the flood hazard was prepared by superimposing the flood potential over the development intensity.

Where is the human interaction with the flood problem? There are no hazards in the flood, it's a natural event. The hazard comes from our development.

In the case of the Waimakariri, works to deal with the flooding problem were started in the middle of the last century. These were replaced by the comprehensive Hays No. 2 Scheme (1928), which was upgraded extensively 30 or so years later to form the existing protection system. This scheme was formally completed in 1989. Apart from one serious breakout of floodwaters in 1957, both schemes have performed very well. They failed, however, to prevent accumulation of gravel in the lower reaches, a problem now largely solved by commercial extraction. Both schemes were built to contain floods only up to a certain design size (the so-called '100 year flood'). Potential damage was not considered and, in the main, physical works such as stopbanks and groynes were used as protection measures.

In marked contrast the approach of the Waimakariri River Floodplain Management Plan is to consider the full spectrum of flood sizes and to match potential damage (averaged over time) by investment in a range of protection measures returning attractive benefits.

In about 1987 we got to the end of the last programme that we were working on and, prior to the introduction of the Resource Management Act, started on this study for the Waimakariri Floodplain Management Plan. In essence we sought to look at all of the options that were available, both structural and non-structural, and looked through them to find what was the optimum or the best method of dealing with the problem. We started off looking at measures which would modify the flood event (many of them were impractical and eliminated very quickly), measures which will modify the susceptibility to flood loss, the various planning options, land-use controls and structural works to flood-proof buildings, preparedness, emergency actions, then options which would modify flood loss burdens, such as insurance, tax deductions, loans and relief funds.

We looked very rapidly at that list, to sort out what was practical and what was going to be a non-starter. We moved down to the more likely options and looked at each option on the basis of physical, economic, social and environmental parameters, and categorized the various measures out of that first long list into an overall assessment of high, very high, moderate, down to not very good at all.

The process left us with some 27 separate measures (see Table 1), which we grouped into options, 1 through to 5, with option 1 being the minimum end of the scale, coming through to 5, which was to have all the measures. In essence, what we did was anything that had a very high return on the first run through went into option 1, very high plus high went into option 2, and so on through the process. Then we evaluated these options, again in terms of physical, economical, social and environmental considerations (see Table 2).

On this occasion we were looking at the whole of the option, and in the physical consideration asked does it work? Does it give you flexibility? How easy or how difficult or practical is it to implement? The economic consideration was relatively straight forward; we simply compared the net present worth of the options. In the social consideration we looked at the people affected, what it did for preparedness, recovery, and the political implications. Was there advantage/disadvantage to recreational uses, cultural aspects and, in the environmental area, the ecology, landscape appearance and amenity. A Community Advisory Committee agreed unanimously on a preferred option (Option 3) which has 18 measures involving river control, land-use management, community preparedness, emergency actions and civil defence.

The aim of the project was to minimise flood damage. In terms of sustainability the objective was to sustain the current development and the economic growth that was occurring on the flood plain. A flood in the Waimakariri could break through the present system at about 75% of the current design standard. In a major flood we could be faced with a damages bill of anything up to $5,000 million, but the probability of that occurring is quite low. If we annualise those costs without any sort of protection system at all, we are looking at an average annual damages bill in the order of $35 million per year.

Table 1 : Flood Plain Management Options

Flood Plain Management Measure	Flood Plain Management Options				
	OPTION 1	OPTION 2	OPTION 3	OPTION 4	OPTION 5
1 Extension of protection planting	•	•	•	•	•
2 Upgrading of existing flood plain groynes	•	•	•	•	•
3 New groynes			•	•	•
4 Extension of rock protection			•	•	•
5 Development of gravel extraction	•	•	•	•	•
6 Upgrading of existing stopbanks				•	•
7 Extension of existing stopbanks	•	•	•	•	•
8 New stopbanks					•
9 Outflow control structures					•
10 Restriction of urbanisation	•	•	•	•	•
11 Re-zoning				•	•
12 Raising of floor levels		•	•	•	•
13 Control, relocation or exclusion of dangerous uses		•	•	•	•
14 Building line restrictions			•	•	•
15 Elevation of building sites			•	•	•
16 Secondary flowpaths					•
17 Extension of existing building codes				•	•
18 Banks and walls					•
19 Waterproofing of structures				•	•
20 Technical advice programme	•	•	•	•	•
21 Development of flood warning systems	•	•	•	•	•
22 Evacuation		•	•	•	•
23 Elevation/protection of contents		•	•	•	•
24 Flood fighting techniques		•	•	•	•
25 Insurance					•
26 Assessment of numbers and location of victims		•	•	•	•
27 Assessment of services disruption		•	•	•	•
Number of measures in option	**7**	**14**	**18**	**22**	**27**

Table 2 : Evaluative Criteria for Flood Plain Management Options

Category	Factor	Main Considerations
Physical	Future Flexibility	Scope for future alteration and implementation of alternatives
	Implementation	Ease or difficulty of construction or instalment
	Effectiveness	Efficiency and reliability
Economic	Net present value	Net costs and benefits arising from implementation during the Plan period (1992-2022) in dollar terms
Social	People affected	Number of people with property flooded plus number indirectly affected in a flood. Total number assessed as three times the number of those directly affected
	Preparedness	Extent to which community is able to respond effectively to flood emergency
	Recovery	Extent to which community is able to deal with victims and restore services
	Political	Strategic, legal, policy and equity aspects; acceptability of operation
	Recreation	Improvement or otherwise in scope, type and frequency of leisure, sports and related activities
	Cultural	Tangata whenua issues and concerns; historic sites; buildings and amenities of cultural significance
Environmental	Ecology	Degree of improvement or otherwise to plant and animal communities and habitat
	Landscape	Enhancement or detraction of aesthetic values; scenic appeal; harmony with existing features
	Amenity	Enhancement or detraction of living environment

With the work that's been done over the last 130 to 140 years, that figure has dropped down to something in the order of $1.5 million per year. In other words the bulk of the problem has been dealt with. The question that this particular investigation is asking is, do we maintain the system at its present level, do we reduce the standard, or do we increase the standard?

In this particular exercise we went a fair way through the study before we started to involve community discussion. In fact, we had done most of the primary investigations and had an idea of the general shape of where it was going; we then formed an advisory committee from community board members and people nominated by various community interest groups. We then ran through the study with them to the stage where we had the options defined and were ready to make a selection.

The plan was advertised and submitted for public comment. There was very little comment, only about ten submissions; however, that was before the introduction of the Resource Management Act. Currently we are developing a series of about half a dozen quite brief regional rules and the plan will be re-advertised under the RMA.

Jeff Jones, General Manager, Bay of Plenty Regional Council

"Upper Kaituna Scheme Works"

I would like to talk to you about just part of a $42 million Kaituna Catchment Control Scheme, that is known as the Upper Kaituna Works. What I want to do today is try and point out some relationships between the problems, the causes, the solutions and sustainable management. The project I'm talking about is now about 95% complete and it's been going on for about the last 10 to 15 years. What I want to demonstrate to you is that sustainable management is not something new, it didn't come in with the Resource Management Act on the 1st of October 1991; people all over the country have been doing it and, in particular, we have, in and around Lake Rotorua.

The problem that we have in Lake Rotorua was first identified as an excessive input of nitrogen and phosphorous from Rotorua's sewage treatment plant and from the agricultural and pastoral land in the catchment of Lake Rotorua. It was identified by, I believe, some American professor who came through in about the late 50s, early 60s. He drew people's attention to it and so a major investigation was undertaken.

The problem was confirmed and sourced to other problems which I will address in a moment. What was decided was that the solution had to be sustainable. In fact we were looking for some sort of sustainable redevelopment or dedevelopment because the problems were as a result of unsustainable development where the forest had been cleared and land had been developed for pastoral purposes right down to the edges of the streams.

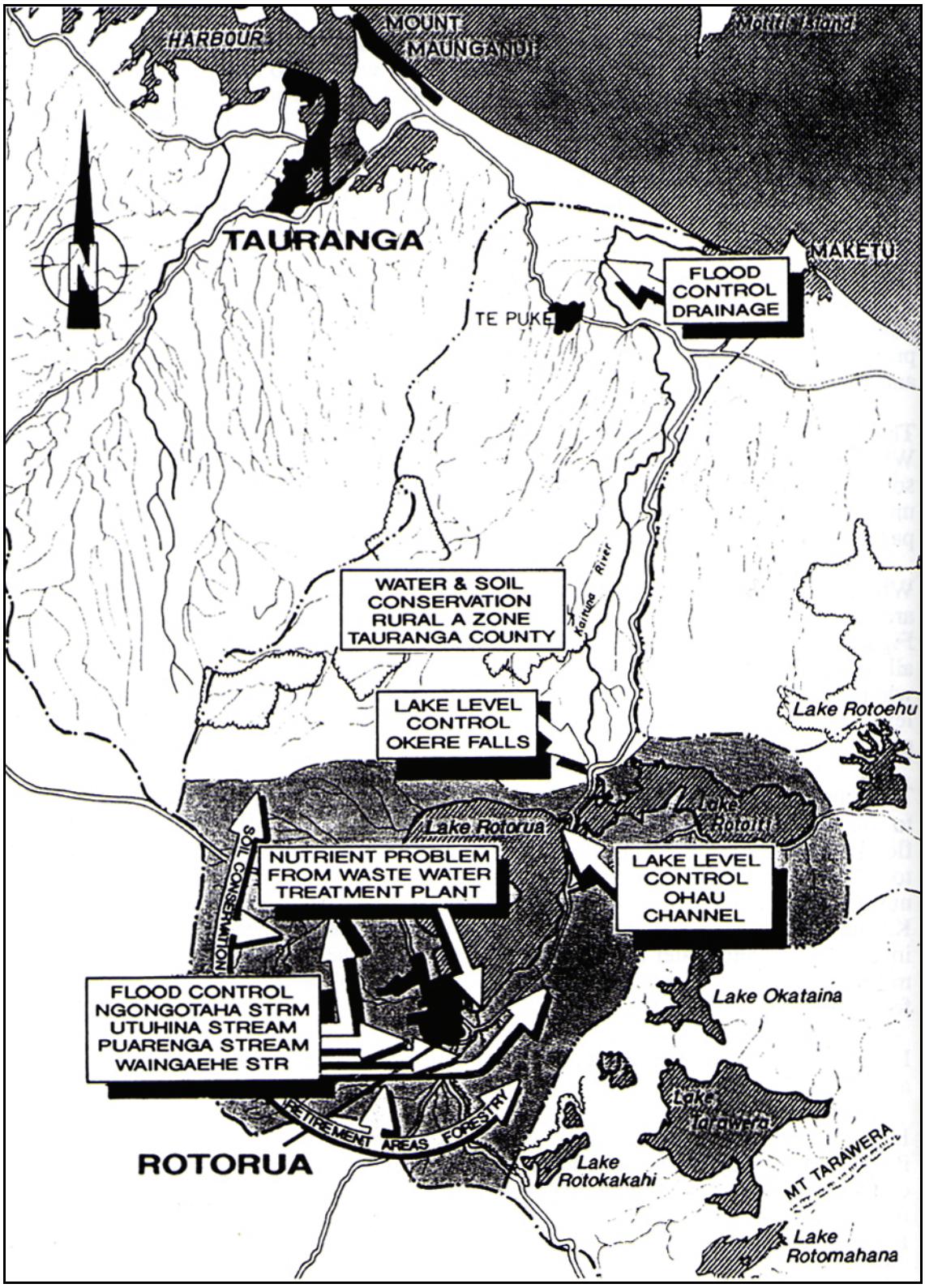
While the scheme was a whole catchment control scheme, I am only talking about the area around Lake Rotorua. The Upper Kaituna Scheme area is mainly the shaded area as shown in Figure 1. The problems were flood control of the tributary streams flowing into Lake Rotorua all of which ran through or very close to Rotorua City. There was also the nutrient problem, which most of you will know about, from the waste water treatment plant, there was a lake level control problem and then there was the requirement to deal with major soil conservation problems around the catchment.

The scheme's objectives were to: prevent further deterioration of the quality in the lakes, indeed to improve the quality of the lake's water; control the lake levels; to provide protection from flooding to urban and rural lands in and about Rotorua City and down into the Kaituna Swamp; to control and prevent soil erosion from the catchment, mainly in the upper area; to control nutrient input into the waterways and provide improved drainage for low-lying farmland in the Kaituna Swamp, in the lower catchment near the sea. Others were to ensure by use of improved soil and water management practices that the natural assets of the catchment were maintained, and to ensure that wherever it was desirable and possible the existing indigenous forest cover be retained.

I draw attention to the fact that all but one of the objectives above apply to the Upper Kaituna area.

In the Upper Kaituna area there were links between the causes and the effects. This is illustrated by way of the schematic diagram (Figure 2). This shows the rain falling on the catchment, the fertiliser input, Rotorua City, Lake Rotorua, the Whakawarawara Forest where the effluent pipeline discharges now, and the natural geothermal inputs which made Lake Rotorua susceptible to nitrogen/phosphorous more so than any other normal lake, such as Lake

Figure 1 : Kaituna Catchment Control Scheme area



Taupo. The very high natural loading of nitrogen/phosphorous, you might be aware, had already resulted in the lake being at just subcritical levels. The other lake in the diagram (Figure 2) is Lake Rotoiti.The resulting eutrophication of the lakes was what really pushed this problem into prominence. As you know Rotorua is one of the prime tourist areas in New Zealand and has been so for many years. Even before the turn of the century people were coming from all over the world to see Rotorua and the geothermal activity. Of course the lakes themselves were also a significant attraction.

What pushed this lake from being just subcritical to overcritical in terms of phosphorous/nitrogen was the nutrient runoff from the Upper Catchment. That nutrient runoff was believed to result from the stock in the Upper Catchment and the application of fertilisers. There was also an urban flooding problem as a result of development in the Upper Catchment, which lead to erosion, resulting in excessive siltation in the lower estuarine section of the stream near the lake where people had decided to build. This aggradation caused the problems with urban flooding. Up in the catchment the soil erosion that was causing this problem was in turn caused by overstocking or unwise pastoral practice.

The high nutrient level in the runoff was contributed to by the fact that pastoral land extended to the stream's edge so the stock were grazing right down to the water's edge. They in turn were also causing physical erosion of the banks. The removal of indigenous forest which also contributed to the problem resulted from the need for a financial return in the short term from the land either from the wood or the need to develop the land into pasture so that it could be grazed. There was thus a relationship between all the causes of the problem.

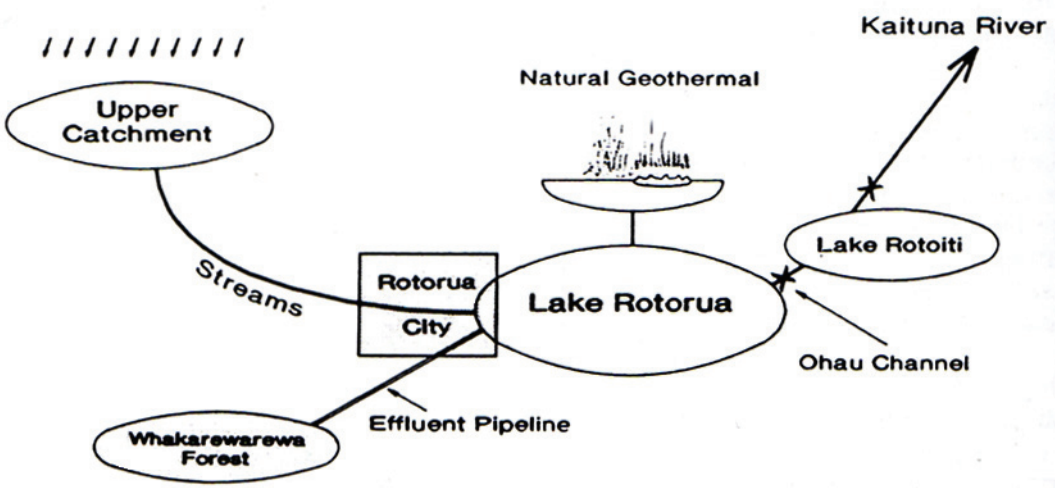
Figure 3 sets out the problems and their solutions. The problem of natural and applied fertiliser runoff, especially phosphorus and nitrogen, was addressed by retirement and planting of stream margins. Retirement prevented the stock grazing right down to the water's edge thus allowing rank growth to occur around the margins of streams which would strip out significant amounts of the nitrogen and phosphorus as it ran over or seeped through the stream margins. It also prevents stock directly eroding the banks and depositing wastes into the stream while they were drinking. The soil erosion, especially gully erosion, that occured on land that should never have been cleared of forest, was addressed by retirement and planting of those areas and the construction of gully control structures and the like.

Down in the city, the existing urban flooding problems were addressed by excavation of channels and stopbanks. Unfortunately, these streams are not like the Heathcote River, they didn't have a convenient road along each edge, most of them were through the back of suburban properties. Many were developed for landscaping purposes and when we had to trundle in there with back hoe and trucks we were not very popular. Trying to point out to people, particularly new people, that we are fixing a flooding problem, when they had never seen it, proved to be quite problem.

Now in terms of sustainable management - nobody can say what we did with the streams in the urban area was sustainable management, we fixed a problem. We used a structural solution of digging out the channels and building stopbanks. All of the other solutions to the Upper Kaituna problems I believe are sustainable management solutions.

The sustainable management solutions, we believe, are as natural as possible, that is the retirement of the margins of the streams. By retirement we mean physically fencing off the margins of the streams, and entering into land improvement agreements with the farmers or future purchasers of the land which registered the fact that the retired land is not available for any development whatsoever. Apart from fence maintenance and noxious weed control, the retired land should manage itself.

Figure 2 : Links Between Upper Kaituna Scheme : Causes and Effects



EFFECT	CAUSE
Eutrophication of lakes	Nutrient runoff from Upper Catchment (N & P)
Urban flooding deposition in	Erosion in Upper Catchment; lower stream channels
Soil erosion	Overstocking or unwise pastoral practice
Nutrient input	Pastoral land to water's edge
Destruction of indigenous forests	Need for financial return (short term) from land

The solutions had to be cost-effective and low impact. The desired solution was permanent sustainability.

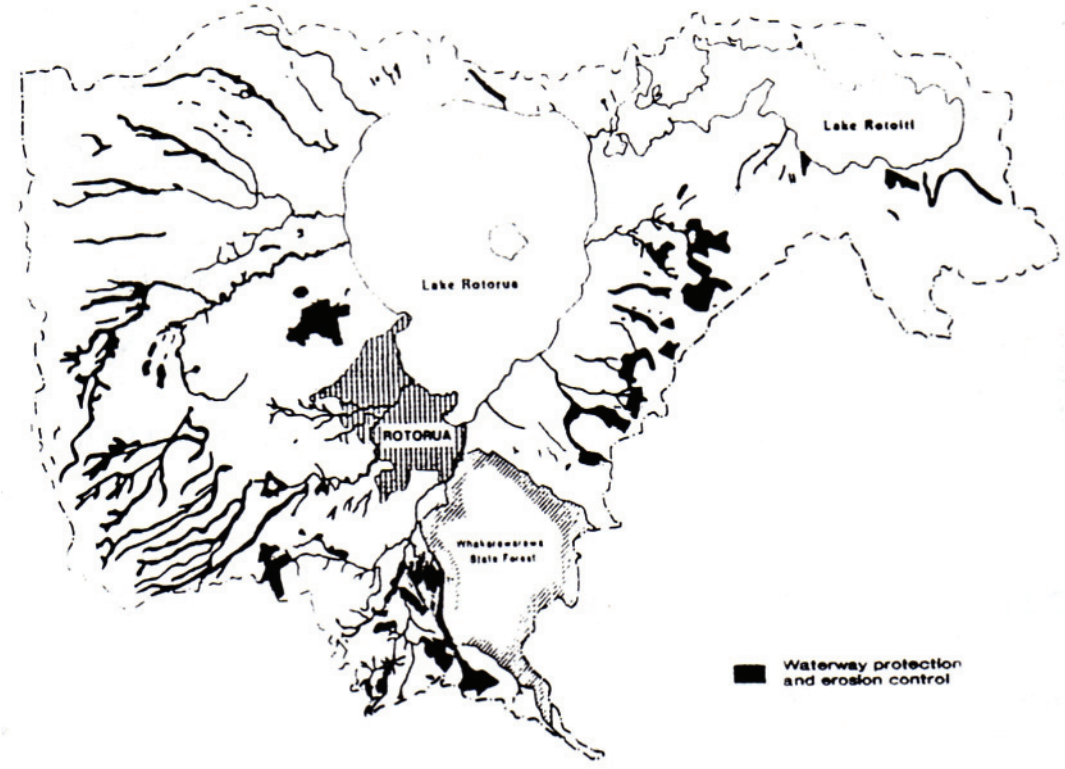
To demonstrate the amount of work that was done, Figure 4 shows Lake Rotorua and environs with the shaded areas being the streams and stream tributaries where work has been done, where the waterways have been protected. There has been quite a few kilometres of fencing constructed and quite a few hectares of land have been retired around the significant streams into Lake Rotorua. Around Lake Rotoiti, which suffered less of a problem, we have done less.

Figure 3 : Upper Kaituna Scheme - Problems and Solutions

PROBLEM	SOLUTION
"Natural" and applied fertiliser runoff especially P and N	Retirement and planting of stream margins
Soil erosion, especially gully erosion	Retirement and planting of affected areas
Stock-induced streambank erosion	Retirement and planting of stream margins
Existing urban flooding	*Channel excavation; stopbank construction
Future urban flooding	All of the above except *

Figure 4 : Sustainability and the Upper Kaituna Scheme Works

Upper Kaituna Scheme - Erosion and stream work
necessary to help reverse lake pollution



Finally, I would like to deal with costs. There was some discussion this morning about the fact that government subsidies were one way of intervening in these sorts of problems. The whole scheme's current costs, which would be just about the final costs, has been about $42M. Table 1 shows the details of these costs. In the Upper Kaituna the soil conservation works have cost about $8.6M, flood protection in and around Rotorua City has cost $2.5M.

It is interesting to examine the intervention of government through subsidy towards the soil conservation works in the Upper Kaituna scheme. As a result of the availability of generous subsidies, when we knocked on the farm gate and said "we want to do something here", we were greeted with a smile because for every $8 we spent $7 was coming from government. That sort of subsidy has now dried up and will never be again.

For the future, we have a problem in that we now have to look at our powers under the Resource Management Act if we are faced with similar problems elsewhere. Unless some alternative financial incentive is provided, I believe there is going to be a lot more difficulty in future in trying to encourage landowners to voluntarily enter into agreements with Regional Councils to take the necessary action to fix problems like these or indeed prevent them happening.

Table 1 : Schedule of Expenditure on the Kaituna Catchment Control Scheme

WORKS	**SUBSIDY**	**FINAL COST** (Estimated to scheme completion June 1992)
UPPPER KAITUNA		
Lake Level Control	7:1	1,577,978
UK Flood Protection	3:1	2,452,296
Establishment	7:1	11,887
Ohau Channel Model	7:1	15,363
Soil Conservation	7:1	8,660,640
LOWER KAITUNA		
Flood Protection	7:1	24,847,120
Drainage	3:1	3,737,904
Wetland Reserve	3:1	131,983
Establishment	3:1	114,220

		41,550,154

DISCUSSION ON SUSTAINABLE MANAGEMENT OF CATCHMENTS

Unknown : *Following on from what you have just said, we are now going to have to look at incentives for getting people to retire land. What about commercial forestry? You talk about retirement and planting and I presume that is a type of conservation forestry; how practical in your experience is it to have commercial forests, such as pine plantations, where you control the felling, the rotational cycle of harvest and everything, to minimise some of the things that otherwise might defeat your objectives if you just had a wholesale clearing? Is that practical do you think?*

Jeff Jones : I believe it is practical. I forgot to mention in my very short address that all over that catchment we have what in old water and soil conservation and rivers control terms used to be called a Section 34 Notice. That means nobody can do any forestry without checking with the Regional Council first. Indeed that requirement extends virtually over the whole of the Bay of Plenty. We now have two full-time staff whose job it is to liaise with the forestry companies to ensure that all of their forest management processes meet minimum standards. Currently we are using the Forestry Guidelines Policy. Properly managed forests will not cause the problems I have described, because harvesting will not happen all over the catchment and the effects on harvested areas will not all happen in the one storm.

Unknown : *What happened with the change in nutrients levels, what did happen with the phosphorous and nitrate in the streams?*

Jeff Jones : A significant contributor was of course Rotorua District Council's treated sewage effluent. While it was tertiary treated sewage effluent, it still contained significant levels of nitrate and phosphorous. The effluent has just been removed from the lake and is now spray-irrigated into into Whakawerawera Forest. The effluent actually finally gets back into the lake of course, but by then it's had all the nitrogen and phosphorous stripped out of it, that is all but about 5% of the raw treated effluent levels. I can't give you the actual figures off the top of my head, but I can get them for you. As far as the lake was concerned, we are talking about a situation which had got very bad. It may be ten years before people start to notice any significant change in the lake water quality. Indeed one phenomenon we've now got in Lake Rotorua, as is now in Taupo and the Waikato River but it started in Lake Rotorua, is water net. This algae is there consuming all this phosphorous and nitrogen and then dying and recycling the nutrients again and causing quite a problem.

Dr Judith Roper-Lindsay : *In riparian strips it has been shown that simply using long grass instead of tree planting, the vegetation can take up to 60 to 70% of the nitrogen from surface runoff.*

Jeff Jones : There is a paper available which I can send you if you like, which describes how we used the Science Centre in Hamilton to do an assessment of how effective the work that was done on one of those catchments, the Ngongotaha Catchment, was. The results are promising, however they ought to be considering the money that was spent there.

Unknown : *Does the retirement of the stream margins significantly reduce flood flows?*

Jeff Jones : Probably not significantly because the design flood flows, the ones that cause the damage, were of course extreme flood events which would overwhelm any sort of streamside retention.

John Peet : *A direct question to Judith Roper-Lindsay but also I think to the other two, the example from Christchurch or from the Heathcote, but I think it's repeated all around the country. Twelve years ago the Christchurch Gas Works closed down. It has been there for more than 100 years. The toxic waste emitted by that Gas Works polluted the Heathcote for a 100 years, destroyed all life in it for a 100 years, and has left residues. There are residues in every major river and stream near every significant industrial source around the country.*

How much of that is actually going out to the sea, how much of that is retained in the sediments and what sort of a problem is it?

Judith Roper-Lindsay : I think there are a lot of "don't knows" in there; you as a chemical engineer would know. I really don't have the experience of a wide range of rivers; I know in the Heathcote situation there was a long programme of dredging to actually lift and take away those sediments, because the Heathcote hasn't had major flood flows for a long time a lot of the things that were dumped in the 70s are still sitting there in the Woolston Loop area, simply because there haven't been the flows to carry them into the Estuary. I don't think that the RMA itself actually addresses the sort of things like this that have accumulated in the past. We can start to look at changes in the future and how they would effect the river and the estuary because we can start to look at all downstream effects of change; but the Ministry for the Environment people might be better equipped to answer that sort of applicability of RMA to the past wrongs.

John Peet : *I am thinking particularly of large scale heavy metal residuals that have relatively recently been found in the Hutt River for example. The levels are astonishing by European standards I understand.*

Jeff Jones : I think if there are areas like this, whether they are in rivers or in dumps up in the hills, that the Regional Councils in particular have a duty to find them, find out what's there and how much and what it's doing, and carefully identify these and have a policy for them in the Regional Policy Statement and then actually come down with a reasonable plan as to how they are going to manage them. They are either going to do nothing and say so, or do something. That's what a Regional Plan is all about, it's a contract with the community. We say we are going to do nothing - what do you think? - and there will be public interaction and something that is acceptable to the community will come out of it. We in the Bay of Plenty are certainly looking around to find out where there are hazardous waste dumps and so on. There's been a lot of timber treatment done in the Bay of Plenty and we've got people looking into that. We've also got people working nationally with the Ministry for the Environment on that issue. In my view, as far as hazardous waste dumps or suchlike are concerned, you've got to find them and then tell the community what you are going to do about them. You then have to check with the community through the process as to whether that is what they want to do, because these things will incur costs to that community if you're going to do something.

Dr Mike Freeman, Canterbury Regional Council

"Sustainable Management of Groundwater"

To give you some background, I am involved in a team coordinating the formulation of a Groundwater Management Plan for the Christchurch and adjacent West Melton area. We are in the difficult position of trying to move from the era of the Water and Soil Conservation Act to the Resource Management Act and we are discovering things as we go along. So all I propose to do today is to go through what groundwater is, some of the issues involved with it, and then go through some of the attempts that we've made in the first instance to try and apply Resource Management Act principles to groundwater management.

Christchurch is not alone in utilising groundwater as the principal source of drinking, industrial or irrigation water. There are a number of other areas in New Zealand where groundwater is a significant existing source of water for various purposes, a minor source, or a rapidly developing source. There are certainly many areas around New Zealand where there is a lot of effort going on to investigate new groundwater resources.

To run briefly through the hydrological cycle, the Waimakariri river is the major source of recharge for the groundwater in the Christchurch area. About 5 to 8 cubic metres of water per second seeps from the Waimakariri river into the Christchurch groundwater resource.

The groundwater moves through gravels, often moving in preferential channels, and you can see from the characteristics of these gravels (which in many ways are similar to quaternary gravels in many other places in New Zealand) the ease with which water and contaminants can migrate down through what are basically just gravels and sand. There is nothing there apart from a thin soil layer in places to impede the progress of contaminants.

Briefly, the Christchurch situation in terms of where the groundwater is coming from and how it works is very similar to that in many other parts of New Zealand, especially in places like the Heretaunga Plains. We've got some rainfall recharge, a large amount of river seepage coming through, and, in Christchurch, we have series of aquifers with a large amount of water flowing straight through and exiting out to sea in the uppermost aquifer. There are major implications for groundwater management arising from the hydrology of the groundwater system. For example, excessive abstraction from the uppermost aquifer would move the seawater/freshwater interface landwards, eventually resulting in seawater intrusion into the freshwater aquifers in coastal areas.

The general groundwater flow patterns in Christchurch involve large amounts of seepage from the Waimakariri river moving under Christchurch in an easterly direction. This flow pattern is mirrored in the water quality data where, in a general sense, most of the groundwater quality that is directly recharged by the river is very high. Groundwater in the more southern areas of the city, which is more influenced by rainfall infiltration, is of a poorer quality - high in nitrate nitrogen and chlorine. Some contamination by organic chemicals in the Christchurch aquifers in this area has occurred. The organic solvents, trichloroethene, 1,1,1-trichloroethane, chloroform and others have been found.

There are many agriculturally-based risks to groundwater quality, most obviously those associated with effluent irrigation or even normal irrigation, which under certain conditions can migrate down into the groundwater. Another phenomenon, becoming more of a risk in Christchurch, particularly on the city outskirts, is leaking sewer systems. Most engineers are more familiar with problems of water infiltrating *into* sewer systems but not the reverse problem when the sewage leaks out of the piping system and into the groundwater. Septic

tank systems and underground storage tanks, especially those storing petroleum products, are other potential sources of contamination.

Old quarries also represent a significant risk to groundwater quality. They frequently expose groundwater that was previously at least protected by a thin soil and gravel layer, and for some reason act as magnets for waste material.

Underground storage tank installations going in in Christchurch are now required to use secondary containment systems which are a major advance on some of the systems that were in use previously. If properly done, they provide a protective shell for spillages, ruptures and a variety of other problems which can occur around service stations with underground storage tanks. There are several other new developing technologies, many of which promise benefits for the oil companies, service stations, regulators and, ultimately, for groundwater protection.

Another major source of groundwater contaminants in the Canterbury Plains are the livestock or, more specifically, the pasture system that they're involved in. Depending on who you believe, around 50 to 80% of the nitrogen that ends up in groundwater comes from the pasture system, either dry or irrigated.

The groundwater resource in the Christchurch-West Melton area is finite. However, the demand for groundwater seems to be steadily increasing. The competing demands for groundwater can result in a number of actual and potential problems arising, such as a reduction in spring flows to rivers like the Avon and the Heathcote, and shallow bores being left 'high and dry' as increased groundwater usage lowers groundwater levels.

Groundwater, particularly in some areas, is extremely vulnerable to contamination. Groundwater contamination is usually very different from surface water contamination in that if someone spills a large amount of oil into a river for example (notwithstanding the previous speaker's comments about elements being left in sediments and ignoring for the moment the immediate effects), for the most part that contamination is here today and gone tomorrow. The same certainly cannot be said about the vast majority of - particularly organic - contaminants in groundwater which basically just sit there, lodge themselves among the crevices and usually continue to ooze out contaminants over a period of years or even decades. Often you don't know about a groundwater contamination incident until it finally ends up in someone's drinking water.

Applying this to the Resource Management Act, before an intervention in resource use can occur it has to be shown that the actual potential (and certainly the word 'potential' has significance in the Christchurch scene) adverse environmental effects warrant management in whatever form. We also need to keep reminding ourselves that management doesn't just necessarily involve rules; the issue may be resolved by information or an educational campaign or may be resolved by some sort of economic instrument such as subsidies, a specific tax, or mechanisms of that nature.

Before any management controls, such as prohibiting certain activities in the vicinity of a bore, can be set out in a plan they have to be comprehensively analysed and justified. Such an analysis would have to assess whether the costs of that control are warranted. For example, could an alternative water supply source be obtained from elsewhere for less cost, or would the cost of treating that water be less than the cost of prohibiting an activity?

I think it is also very useful for us to remind ourselves of what would happen to a groundwater system, such as the Christchurch system, if there was no management. I think it is quite clear that certain things will definitely occur such as widespread long-term chemical contamination of shallow unconfined aquifers, those aquifers not protected by thick surface sediments, and also any confined aquifers that are then subsequently recharged by the unconfined aquifers. That is certain, it's just a question of when. We have got minor incidents occurring every few months

around Christchurch, one very recently that we have only become aware of through a number of chance processes. That's not the tip of the iceberg but I think it's indicative of what could happen and obviously there are many examples of serious groundwater contamination overseas.

I think it is also quite clear that if there was no management there would be depletion of water levels that would leave many existing users either completely without water or with much reduced supplies.That's certainly an issue on the outskirts of Christchurch where 50 years ago, all people had to do was put down a very shallow bore, maybe 12 metres deep, which would have been quite sufficient to get as much water as was needed. As time moves on, people put down deeper bores, there's more water extracted from the system, and eventually the point may be reached where there isn't any more water in that 12 metre deep bore anymore. A major issue is trying to establish what is the appropriate groundwater level to maintain, and whether any specific use has priority.

And lastly the point I raised earlier about seawater intrusion; with enough abstraction from the uppermost confined aquifer in Christchurch, seawater intrusions could occur.

Again, just to re-emphasise that the costs of not managing groundwater systems will be enormous, there are frightening figures available from overseas, from western Europe and North America, as to the costs of rectifying some of their problems. One serious petrol leak from a US service station cost over $US5 million to reduce the contamination and treat the water.

We need to understand the complexities of groundwater systems to be able to apply sustainable management principles. For example, we need to clearly distinguish between different issues in different areas. There is a difference here between identifying a level that is going to maintain a freshwater/seawater interface out to sea - that's one issue. It's quite another to be on the inland plains trying to decide who has priority - the woman who put her shallow bore down a hundred years ago, or the fifty or so new orchards that have put deep bores in - what is an appropriate water level for that area?

Some of these issues are more easily understood as allocation decisions rather than obvious sustainable management issues. However, the term 'sustainable management' has a very broad meaning under the Resource Management Act and includes social and economic considerations.

Applying the very broad concept of sustainable management to groundwater is not straight forward. We've still got to play with some of these things yet in our own plan, but the basis of it would be to ensure that both present and future generations have access to adequate quantities of high-quality groundwater. Obviously, words like 'adequate' and 'high-quality' would have to be better defined. We also need to remember that groundwater and surface water systems are usually linked. Any groundwater plan would have to recognise the receiving water system - either another groundwater system or, in the Christchurch system and many others, groundwater can resurface in other water systems and be a source of recharge in springs for example. So we have to look at, for example, managing for contaminants in groundwater that might not have any effect on people drinking it, but which may kill every fish in the spring which the water recharges. That's certainly an issue with some particular chemicals.

In conclusion, in terms of the Resource Management Act our attempt to interpret sustainable management is to say that for most groundwater resources in New Zealand there will be a need for a proactive intervention programme to manage groundwater. And, for groundwater resources such as those in Christchurch, it's clear that some regulatory controls are necessary if we want to pass the resource on to future generations as we found it.

DISCUSSION

Tom Fookes : *I got an implication of what you were saying and just wanted to check this because I think it's quite important. Do you feel that there is a tension between the provisions of Section 5 (2) with the definition of sustainable management and the Section 32 tests? What I suspected you were saying is that in the water quality area you would perhaps have difficulty imposing costs, even if they were simply a consequence of complying with the overall requirement of Section 5(2)(a) and (b), that is sustaining the potential and safeguarding the life supporting capacity?*

Mike Freeman : No, I don't think there's a real conflict. I think it's really only slowly dawning on us exactly how much justification, how much of the Section 32 analysis, is going to be required in, for example, water quality standards for the groundwater in Christchurch. Some might say an appropriate standard would be the drinking water standard, it's primarily used for drinking water, it sounds like a pretty high quality test to me, why don't you put that standard on it? But the implications of that, on a large part of the groundwater system, would be significant deterioration in quality down to that drinking water standard. The nitrate nitrogen concentration in most of the deep groundwater in Christchurch is around 1 milligram per litre; if we adopted 10 milligrams per litre, that would involve a significant amount of contamination. Now if we adopted 1 milligram per litre for example, we would have to go through a severe test in terms of Section 32, and also in terms of Sections 5,6,7 and 8, to justify why 1 or 10 or some figure in between is necessary. Some of that justification may be technical, some of it may be philosophical, but it would have to comply with Section 5 in terms of that fairly long-winded definition of sustainable management.

Tom Fookes : *Yes, I would have thought that you would still have to demonstrate it. I'm just wondering how far one needs to go if you are able to demonstrate that a lower level of concentration of something put in jeopardy the life-supporting capability of that groundwater - it seems to be that given the priorities of Section 5 then you wouldn't have to do any more - once you'd established that test?*

Mike Freeman : Yes, but that test would only apply say, to a concentration of 10, and it's only an off-the-cuff reaction, but if we went to the people of Christchurch, given that more and more people are becoming aware of the groundwater resource, and said, look we're planning to manage this resource. What we plan to do is let everybody stick as much nitrate nitrogen into the groundwater as they can until it gets to 9.999 milligrams per litre, but less than 10 milligrams per litre is safe - but we're going to let it be contaminated from 1-9.999 milligrams per litre because less than 10 is considered to be safe. I suspect that, from a philosophical perspective, that wouldn't wash. That if the quality at the moment in general is 1 milligram per litre there would be significant pressure to maintain it at 1 milligram per litre, even though from a purely health perspective, less than 10 milligrams per litre would be safe.

SUSTAINABLE MANAGEMENT OF WASTES

Liquid Waste

Solid Waste

Mr Jim Bradley, Royds Garden Limited, Dunedin

"Sustainable Management of Wastes - Liquid Waste"

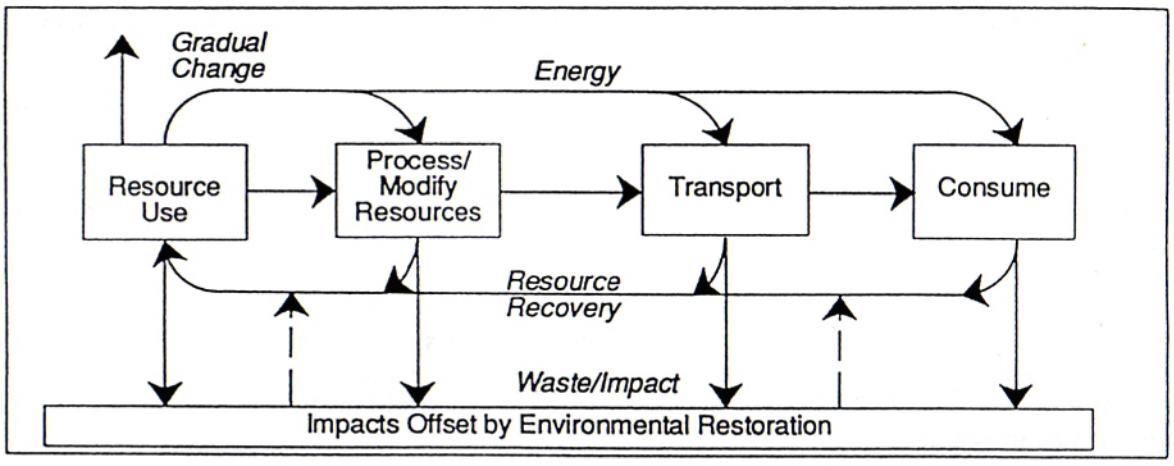
I am going to talk in a general way for the first few minutes, because I think there are a few principles about waste management that we need to get right before we go over the technologies.

There is no significance in the fact that waste management has been carved up into two ten-minute bits, because that is actually the wrong way to tackle waste management; waste management is all about integration and in practice wastes should all be considered together. The next question we need to ask is the philosophical question: if we've got waste, have we blown it already? Have we passed the sustainability limit ? The purest answer is probably yes, but the real answer is no.

The next question is, what is waste? We are groping with that in New Zealand at the moment, and in the Ministry's discussion paper (*Directions for Better Waste Management in New Zealand*, Dec. 1991) the first section is all about defining waste. The definition they like is that waste is something you can put on a truck or in a 44 gallon drum or it goes in the rubbish tin. The Otago Regional Council, with whom I'm working on this, likes to bring the pollution bit into it as well; so, we've got to get the definition of waste correct and all use the same one.

So let's say we have waste, whether it's on a truck or it's gone into pollution. If we look at the sustainability model that I like, from a publication by the International Federation of Independent Consulting Engineers (see Figure 1), what we are doing is driving around the circuit trying not to have any waste - but of course we do. So looking at our sustainability model, what we are really aiming to do is to have the impacts offset by environmental restoration. In other words, being able to manage these wastes in a sustainable way.

Figure 1 : Elements of a Sustainable System



Let's try and put this into a couple of buzz phrases, the two parts, as we see it, of waste management - the sustainable management of the receiving environment and, of course, the sustainability of the resources.

Let's go back to the Ministry's discussion draft and flesh that out a bit: "Waste management solutions should reflect as nearly as possible natural processes of breakdown and renewal" - the restoration bit. "Life-cycle approaches which consider all aspects of resource use, waste generation, storage, transport, treatments, and disposal" - the total picture. "Waste management strategies should work towards longer-term goals" - not just addressing the immediate needs. Right, let's put it in a simpler way that the kids can understand and, with respect, a lot of politicians can understand. The question is: reduce, reuse, recycle, respond - if we do all that, have we got wastes? Maybe not, but we may not be able to do it all; we usually can't.

Let's just take that a bit further. In a statement in his address *The Cost to be Clean* at the WPCF Annual Conference in 1990, William Riley, the Chief of the United States Environmental Protection Agency, said: "This ethic must drive future strategies. Efforts in the past have tended to be medium- or pollutant-specific, not taking into account the fundamental truth that everything on earth is interconnected. Strategies to remove pollutants from one medium often means they wind up in others." That's the whole new concept that many of us have and, by default, known about but not fully appreciated. So in our waste management, before we get into the technologies, we've got to get to grips with the buzz words and what they mean in real life, words like 'mixed-media effects' or 'trans-media' or 'cross-media'. Let's apply this principle of cross-media effects and, in terms of my topic, the question is: Out of water into what? In taking a pollutant out of water, where does it go, what happens next? We don't just look at sewerage treatment and what goes down the pipe and what goes through the treatment plant and the effluent that comes out the end - what about all the interrelated things? In waste water management there are all the residuals that come out of the process as we treat that sewerage, and we have to look at the cross-media effects of those.

We are just about at the technologies, but first I would like to go back to the Globe 90 Conference, the major international sustainability environment conference in 1990. New Zealand got special mention for where it was then in its Resource Management Bill. For those of us in the practical world, we've had all the big words about thinking globally, acting locally, getting the details right. That's where we're going to drive the thing from to achieve these goals.

Moving to the technologies, these can be conveniently grouped under water conservation, water treatment, non-point-source pollution and point-source liquid wastes.

The sustainable aspects of water conservation; firstly, is it sensible to do it in certain cases? If it is, what are we trying to achieve and why? Do we need water meters, do we use those to reduce water consumption? Yes, effective in the right place. Do we reduce the pressure of supply, to save energy in pumping? Yes, it can be effective. Do we fix leaks in our reticulated systems, or seal our sewers? Yes. All practical things. What about the cost of the supply to limit water consumption?

Water treatment, let's optimise our chemical use or, better still, reduce or eliminate our chemical use and trade-off that reduction in chemical use against a possibly rougher microbiological quality that we may be able to accept. Save the resources, trade off in terms of the public-health end of sustainability.

We've heard a bit about non-point-source pollution, and I think Rotorua's been mentioned and Mike had something on that, so I am not going to go into non point-source pollution in detail. But what about Lake Hayes, how are we going to control the fertiliser application? Are we going to generate a natural wetland? Are we going to treat the lake? These are exercises that the Otago

Regional Council's worked through and put $2-3 million on to try and solve. A later model than Rotorua. But technologies seem to be there. Can we apply them?

Let's go to one probably closest to my heart, liquid-waste management point-source. In other words, sewage and waste waters. Of course the first overriding thing is to minimise the waste. The next bit of my message is to target the pollutants that matter, these are the 'priority pollutants', and in many cases that's our hazardous wastes, our toxics, our nasties. Get trade waste control right and get it right by new technologies, clean technologies that don't generate waste rather than fixing the ones that do. Use a dry process if you can rather than a wet. Recycle the chrome in the tannery, get those technologies right for the priority pollutants before they get into the waste stream, and then target them at the treatment plants. One of my theme songs is this great bogie of treating organic strength BOD, particularly the soluble fractions; for example, meat wastes when they are going to the ocean. The ocean can probably accept that. If we do treat it what will it cost, but more importantly, what are the other environmental aspects in the sustainability model?

Following that, use the assimilation capacity that we've got available. Once we've got the priority pollutants, use that to run our treatment models, our operating costs, to keep our industries in business using the right technologies. Tailor-make the treatment processes and use the assimilating capacity in accordance with the discharge permits or consents one can get.

Natural treatment systems - great - oxidation ponds, wetlands; they have got a lot to offer, but of course we've got a trade off on the land use question - but that land is still available.

Resource reuse - a whole bunch of these in the waste water game. The cost of them don't usually stack up too well, but the liquid value of effluent on to land and the various reuse techniques of sludge are proven and working well. There are great developments internationally in things like sludge-to-oil, or smelting sludge to form road aggregates or concrete brick material.

Systems controls - dissolved oxygen nuration systems save energy, save mechanical running and they are simple and effective. Disinfection, the question for example of using UV light that uses electricity from hydro (which we are told might be sustainable) against chemicals. And of course, above all that, integration.

The final message, therefore, is that we can't take it out of isolation. We've got to pull it all together in a total environmental approach.

Mr Charles Willmot, Connell Wagner Rankine & Hill Ltd

"Sustainable Management of Wastes - Solid Waste"

What I'd like to say to you right now is why did you come here today? Did you actually come here for some particular purpose?

Certainly, I hope you did not come to learn how to administer the Resource Management Act because, whilst we've learnt a few little bits and pieces about it, you wouldn't be able to go away today and suddenly claim to know how to administer that Act. In fact, it is an extremely complicated Act, and I am going to plagiarise a famous lawyer by saying that anybody who thinks they understand it blatantly and obviously doesn't understand anything about it at all. Maybe you came to find out what sustainability means, and to a certain extent I think we've probably done very well at getting something out of sustainability and finding out at least an idea of what it really means. But certainly I hope that one thing you really did come here for was to initiate a thought process. If it wasn't initiated already then you had a chance to really start thinking about what it is that we are doing now instead of what we have been doing since, not just October 1st, but in the past few years with regard to the resources that we know that we have. Public perception of those resources dwindling has meant that we have had to act to change the ways in which we traditionally did things.

From my point of view, sustainability and time are really interlocked, totally interlocked. There's no way in which you can separate them and say that this is sustainable and this isn't, but rather that this is sustainable over a certain period of time. If you wish that time limit to be extended or reduced then the sustainability factor will need to change somewhat and I'll illustrate that with a quote from a newspaper headline that says that:

"*The World Will Be Thrown Into Darkness Within Ten Years*"

The article went on to explain that:

"*Eminent scientists claim our resources are finite and careful scientific study has proved that resources able to provide light in our homes and in our work places will run out due to overkilling of whales and the inability to extract the whale oil required for our lamps*."

That was a 19th century quote.

All too often, as engineers, we are asked to find practical solutions, solutions to practical problems. As the Resource Management Act was being passed, in fact for probably two to three years before that, we saw consulting engineers searching for a dictionary, because they had to look up the word 'sustainability'.

Well sustainability isn't really a dictionary definition - it's a concept, it's a vision. And, as such, in order to begin to understand what it is, you need to have a very wide, very broad vision.

I would like to tell you a little bit about my philosophy with regard to the concept of growth. In fact, in my opinion, if you are not growing you are actually dying, because you can't stay stable. I've noticed that there is a slight problem with this sustainability concept and that is that we are trying to maintain something on a stable basis whereas in fact perhaps we should be thinking in terms of growing in one direction or another because the mere process of remaining stable may in fact be detrimental.

When people think of solid waste management in New Zealand they automatically think of the local dump, or (if they are lucky enough to live in Christchurch here) maybe the local transfer station. Whichever, the ultimate destination of that waste is inevitably landfill. Due to the convenience and the economy of that form of disposal, landfill is undoubtedly here to stay in New Zealand. What's more, although Tom may well like to disagree with me here, I think landfill is probably quite sustainable, over a period of time. In a country as large as New Zealand, with only 3.5 million people, it will remain sustainable for many, many years.

What we have to decide, however, is whether the resources that we are going to put into that landfill are going to continue to be the resources we presently put in. Or are they going to be far less valuable resources that we placed in there, and are we prepared to dissipate those resources amongst landfill rather than pay the dramatic charges that would be incorporated in somehow collecting all those resources together and re-using them. In actual fact, I think it is this very sustainability that landfill has that causes so many of those people who care for the environment so much concern.

There are many sites throughout New Zealand eminently suitable for waste disposal - even in Auckland. A private company is busy proving that right now by continuing through the final stages of obtaining approvals to start construction of what I believe may be the first privately owned, environmentally-sound landfill in New Zealand. So the land is available.

So if we are claiming that the landfill is sustainable, what's all the fuss about? Land is plentiful and so it is this very sustainability that we now wish to protect. It will not continue to be sustainable forevermore. The time concept becomes involved here and what we are saying is that we want to protect the sustainability that we presently have and so in order to do that we have to be more sustainable in our other forms of waste. Lets put it this way. Just because you have a lot of some resource does not give any reason to squander it. Even in today's recessionary climate the people are voting with their pockets. Where possible people are looking for environmentally friendly products. People are also keen to know that their refuse is being treated and disposed of in a responsible manner, even if at a greater cost. The next step is to ensure that the products that we manufacture and purchase are made in the most environmentally friendly way. The terminology is 'Cleaner Production'.

Do we all need to tighten our belts, reduce consumption in order to achieve this in a cost effective way. In my personal opinion, no we don't.

So we end up without really having settled the question of sustainability. I hope that when you came here you didn't hope that you would actually solve it, but I do hope that what I've said is provocative and thought provoking. I suggest that you take it with a little pinch of salt because in actual fact what I've said is not necessarily the opinion of the Waste Management Institute nor my employers, and the next time that you have the opportunity to have an effect on the community I'd like you to just think for a moment and say to yourself - is what I am doing sustainable?

In that regard I'll just quickly talk about the packaging industry and a couple of quotes. I picked up a marketing magazine while I was at the Airport this morning, where it says ...

> "*Disposal packaging has become a fact of life, part of the throw away decadent society of the nineties....*", this is supposed to be in favour of packaging and showing how environmentally sensitive they are, "*... the General Manager of Printpac, UEB Carton Group, Rod Sera, believes on the whole consumers in New Zealand are quite ignorant about the nature of packaging in general. We still see claims that using recycled paper will save trees...*" - when for many years there's been no question of using indigenous forests for paper-making in New Zealand, so it's alright.

Another quote says:

> "*One Company which has taken its environmental responsibility beyond end user recycling, Tetrapac...*", the people who produced the orange cartons, "*...National Sales Manager, Andrew Pooch, said that Tetrapac had been interested in the environment for more than 10 years*."

They haven't just jumped on the 90s recycling bandwagon, in fact :

> "*...the Company believes end user recycling plays only a minor part in protecting the environment and does little to save natural resources. Since the packages are primarily in contact with food, and could therefore cause contamination if they were recycled, we believe they should instead be easily compacted for use in landfill*."

There we are, this is the sort of thing that's coming from industry. And so it's to industry we have to go if we want to see that sustainability in a waste stream is actually being effective.

DISCUSSION ON SUSTAINABLE MANAGEMENT OF WASTES

Malcolm Douglass : *Jim you showed us some sludge figures for industry and residential, wastes, domestic wastes. Can you just give us a bit more background, because the sludge figures for industry were so much greater than the ones for residential and yet in the particular town you were talking about I didn't think it had that volume of industry. I was intrigued about that. Then the aspect of the separation process - could you just go through the logic again on that. I presume it's the pollution effects from the residential area you see as higher risk than the ones from industry?*

Jim Bradley : It's a whole balanced integrated approach, and Wanganui is a specific case where very conveniently, from a Town Planning view, we have a very high amount of wet organic industries in one area. This allows you to select them separately, collect them and treat them if you want to. There's two freezing works and a tannery, woolscourers and a fish factory, and on average their organic strength in the concentration base is about four times domestic strength. So we have 40,000 people real and about 300-400,000 people equivalent organically. Now the message there was, if we take take an 8- to 10-fold organic load and biologically treat it and convert even more sludge, the problem becomes enormous relative to the people one. The other side of the equation is that because of the town planning, the physical topography, the layout of the place, it is possible to pick the domestic waste up, treat it separately and dispose of it. The land disposal came through and, of course, that meets the cultural aspect to a very high degree and it attacks the pathogenic end of the domestic area, which is not seen to be of the same concern as the pathogenic end of industry. And of course, by leaving the industry with appropriate priority pollutant attack and still going to sea, we've saved that organic treatment, that secondary treatment.

Mr Ian McChesney, Centre for Resource Management, Lincoln University

"Sustainable Management and the Efficient Use of Energy"

I would like to start on the question of energy and sustainability with a quote from someone who helped write the Brundtland Report in 1987:

> "Present energy systems based largely on the burning of fossil fuels are the most obviously unsustainable of human activities. Present levels of use of fossil fuels are warming the planet; yet population growth and any conceivable form of 'development' for three-quarters of humankind who live in the developing world will require more energy."

From a global perspective I think that sums up the nub of the problem. The energy pathway at the moment is unsustainable. What is sustainable management of energy? I guess we've had about ten different definitions of sustainability today, so I'll throw my lot in for energy - what needs to be sustained?

The first thing that we are trying to sustain is the environment, the life supporting systems of the environment; reducing the harms from energy production and use to within allowable limits. Now that raises a lot of questions; what are allowable limits? What are the harms? There are a lot of uncertainties about this, but it sets the general direction.

The second point is sustaining essential and desirable energy services, for all people now and in the future. We are talking about the question of *sufficiency* of energy, we are talking about *energy services* rather than just energy supply, and we are talking about equity.

It is sometimes easier to focus on what is unsustainable about our current energy use, in order to to steer us in the direction of what we might do to turn it around. In New Zealand at the moment we have an interesting example in the Resource Management Act, which is asking us to take sustainability into account and to manage our resources on a sustainable basis. Yet we have an energy pathway which, if projected into the future, is clearly heading us in an unsustainable direction.

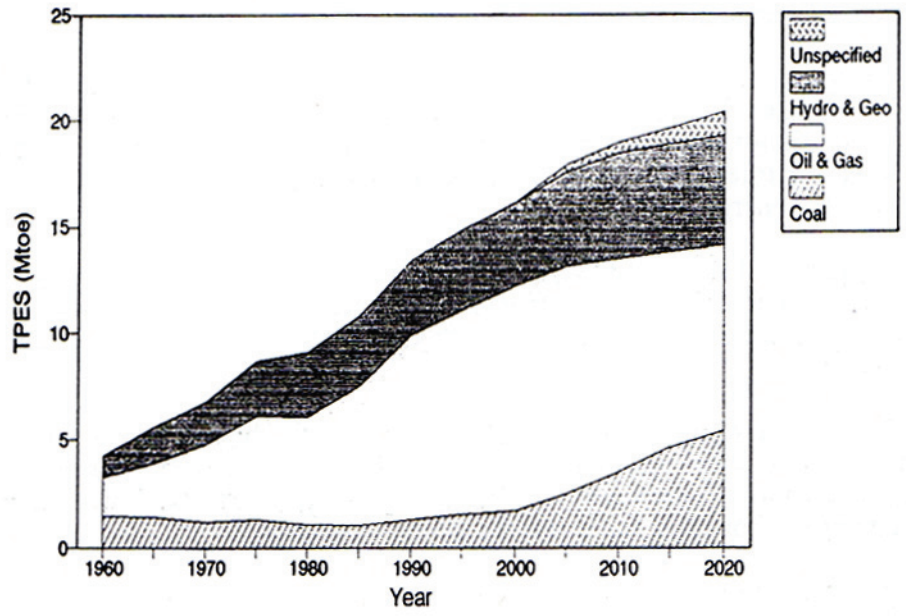
Figure 1 is the projection of where New Zealand's energy pathway is taking us if we follow what is called a 'business-as-usual approach'. We've seen a large increase in our primary energy use over the last ten years largely due to the development of the Maui Field. The projections are that if we carry on the business-as-usual approach, energy growth will continue to increase through to the year 2005, which is about the time that Maui Gas is due to be depleted - and the projections really are that growth would continue beyond that as well.

What are the implications of energy growth of this nature? First is the question of energy security. Maui Gas is currently supplying roughly one-third of the primary energy for our country. When that is depleted around 2005-2010 that is going to produce a pretty large energy hole which will have to be filled by some other energy source. We don't know what that is at the moment, but there is a clear indication that if we do not find more gas fields or more oil fields then it will be filled by coal.

In Figure 1 there is an indication that, even regardless of exactly the pathway we choose to replace Maui Gas, there are strong projections that our use of fossil fuels is going to increase substantially over the next two decades. If we don't find indigenous oil and further gas, then it seems highly likely that our imports of oil and oil products will increase again after the turn of

the century, and that will be at a time when worldwide the reserves of oil will become more concentrated in the Middle East. I think we have to ask some serious questions about the stability of our oil supplies.

Figure 1 : Business-as-usual Pathway of Total Primary Energy Supply (TPES)



There is also a gap shown at the top of Figure 1, and we are really not quite sure how it might be filled. It might be filled by more coal, more gas, more oil, depending on what energy reserves we might discover. So I believe there are grave questions over the energy security of that sort of approach.

The other question particularly concerned with sustainability is the environmental implications. The New Zealand Government has a target of reducing CO_2 emissions by 20% by the year 2000. Regardless of whether that becomes a specific goal, New Zealand is one of many countries that are working towards an international climate convention, hopefully to be signed at the Earth Summit in Rio in June of this year. This will likely commit countries to specific goals to reduce CO_2 emissions. We don't really know what they may be at this stage, they may well be something around stabilisation by 2000. But I think what we can say is that we are heading towards an international scenario where we are going to have to start limiting CO_2 emissions and fossil fuel use.

The business-as-usual scenario doesn't really accommodate that at all. Instead of reducing CO_2 in the year 2000, CO_2 emissions would have increased by around 20%; by the year 2010 they would have increased by 40%. So from the environmental sustainability viewpoint, it's heading in the wrong direction as well.

There is a third point, and that is the whole question of economic development and economic stability. I would doubt very much whether this is a pathway towards a sustainable economic future because, I believe, if we are following this pathway, then we are fundamentally undervaluing our energy resources. If we are undervaluing and underpricing our energy resources then we are probably also continuing to encourage energy intensive industries and

they, on the basis of past experience, are not the sort of industries which are going to provide wealth and jobs for New Zealand.

So on a number of counts, the business-as-usual approach is, I believe, an unstable pathway to the future.

If we are looking at sustainability, and trying to take that concept seriously, then we've got to create a different pathway. I think this idea of creating something different is quite important. It's entirely our decision what approach to take, and I think it's quite within our realms of possibility to look at where we are now and say, we don't actually need to follow our trend from the past; we can actually turn things around and do something different. This alternative pathway was really designed to say, let's see if we can deliver the same level of *energy service* as the business-as-usual pathway; that is, we are not trying to put a block on economic growth, but let's see if we can do it in ways that promote environmental sustainability, promote energy security and promote economic opportunities.

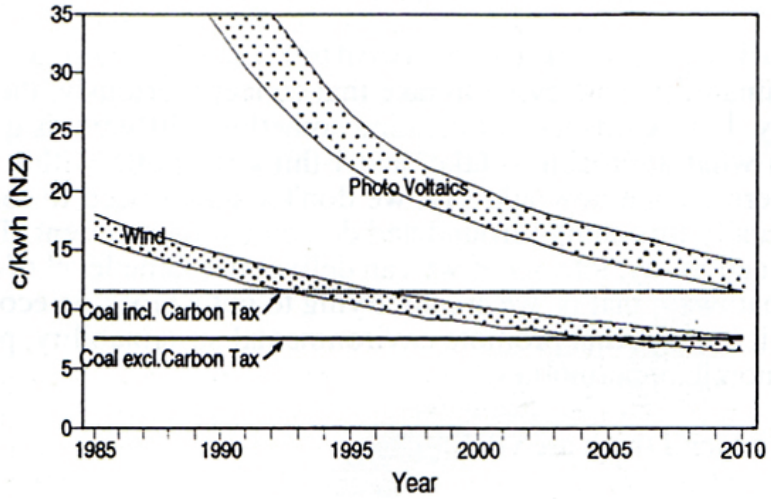
There are three strategies which I think are vital.

The first is to improve end-use efficiency. It's difficult to tell how efficient New Zealand is in terms of its energy use compared to other countries. We certainly had a large growth in energy use over the last ten years with very little economic growth, so from that point of view it could be suggested that we are not all that energy efficient. I think in many industrial processes we are not really too far behind the rest, but I think worldwide we are beginning to see that there is enormous scope for energy efficiency savings, end-use savings, by using new technology, by using new information systems, and simply by better housekeeping. What I am suggesting in this particular scenario is that if we can aim for what I believe is a reasonably modest target of 1% per annum improvement in end-use efficiency, then in thirty years time we will be 30% ahead of the business-as-usual pathway. Essentially we will be able to have the same level of energy service provided but with up to 30% less primary energy required.

The second approach that we've got to focus on is the energy waste within our energy supply system. Currently two-thirds of Maui Gas goes into two industries which are transforming that energy into other energy forms. One-third goes into synthetic petrol where the gas is converted to petrol at roughly 50% wastage. The other one-third goes into electricity production, in which two-thirds of the gas is transformed into waste. So we've got a situation where between 50-60% of the energy value of the natural gas is being wasted. In the business-as-usual scenarios we are looking at increasing our use of thermal power stations and thermal power stations (even with the best technology) produce electricity, at best, at around 45% efficiency. There is a potential for further enormous waste from our electricity system if we continue on the path that we are going. I believe that we have the potential to be looking at alternative electricity generation sources such as wind which, within ten years, will be economic and cost competitive with coal-fired power stations (see Figure 2).

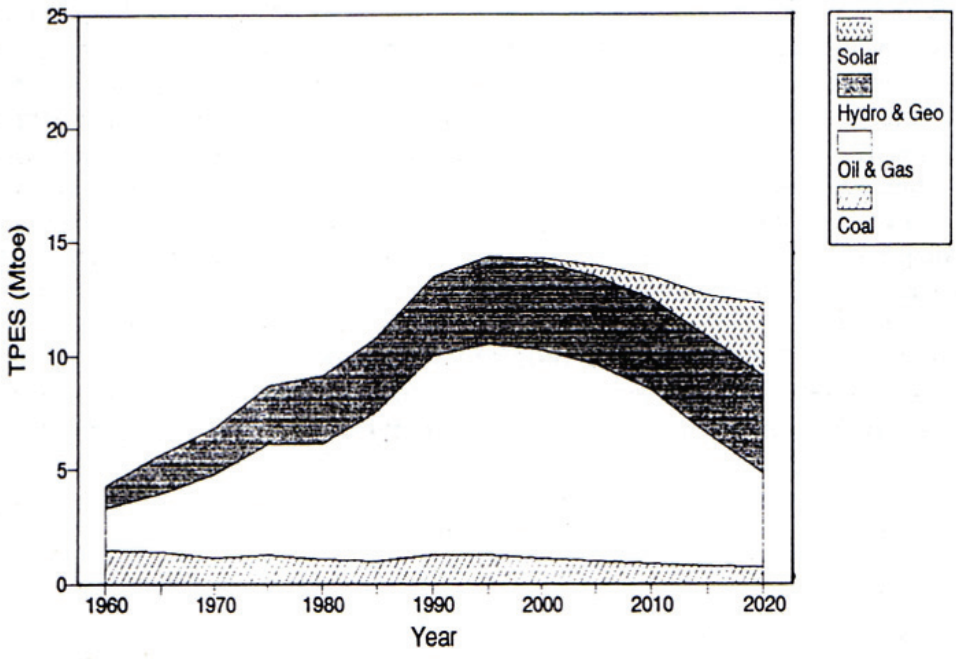
So there is a technological transformation required within our energy industry. One of the difficulties we have at the moment is that information on some of the new technology renewables is not being presented to the energy planning process. The energy planning process is largely being driven by the Energy Sector and I believe we've got to try to introduce the idea of new technologies and renewable systems into that planning process.

Figure 2 : Projected Electricity Costs from Wind and Photovoltaics versus Coal



The third approach is that we have got to progressively plan for renewable technologies. This is indicated in Figure 3 by the solar contribution supplying an increasing proportion of our primary energy over the next 30 years and beyond. I think we are in a great position to do that now and to phase it in gradually. I don't think we need to go into a crash programme because we've basically got the next decade where we have a relatively stable supply of energy in which we can actually field test some of these technologies, see how they all work in New Zealand and try and develop the infrastructure for the industry which would be required.

Figure 3 : 'Sustainable Energy' Pathway of Total Primary Energy Supply (TPES)



(Based on actual demand up to 1990 and author's calculations through to 2020)

I believe it's perfectly feasible to look at solar energy starting to provide an increasing proportion of our primary energy.

On the question of sustainability, this scenario would stabilise CO_2 by the year 2000 and emissions would progressively decrease from then on. By the year 2020 CO_2 emissions would be some 50% lower than they are now, and of course they would continue to decline and would be only one-third the level of the business-as-usual approach.

Remember that this is a scenario which says we don't have to put a brake on our economy by limiting the energy available to the economic process; we can still supply the same level of energy services, but let's reorientate our thinking towards efficiency and renewable technologies.

I might finish by trying to bring this back to the Resource Management Act. I think it's fair to say that energy is more an ancillary than a primary focus of the Resource Management Act, and I don't think that we can expect that local energy initiatives are going to be a substitute for action at a national level or indeed at an international level. But I believe the purpose and principles of the Resource Management Act in terms of efficient use of resources, in terms of mitigating the effects on the environment, covers energy, and I think the Resource Management Act probably provides a mandate for Regional Councils to start considering the impacts of energy use. I would suggest that provisions for public input to Regional Plans will probably force it, and I am sure that the public will begin insisting that Regional Councils, through the Resource Management Act, start considering the impacts of energy use. There could also be a more explicit indication provided by a National Policy Statement on climate change which would give Regional Councils some direction as to what they should be following perhaps in the way of improving the efficiency of energy use.

I don't believe it's necessary to wait for a National Policy Statement. There are aspects of the energy issue that Regional Councils can be looking at now, for example, in transport planning where transport is one very large contributor to energy use and CO_2 emissions in the built environment.

For Central Government to achieve it's objectives of reducing CO_2 emissions there will need to be a degree of working together with Local Government to ensure that there is consistency and cohesiveness between the policy objectives of the respective organisations. I would suggest that probably over the next couple of years we are on something of a learning curve - I don't think we quite know what Councils can do under the Resource Management Act in relation to energy, and I guess it will be a process of some trial and error to see what may come out of it. I certainly feel that there is adequate scope for Councils to become much more pro-active in the area of energy. I would suggest that it's an area that needs some leadership and I think it's appropriate that Regional Councils should start to show some leadership in steering the course of the current energy pathway away from what is a clearly unsustainable approach at a national level, and indicating to Central Government that that sort of pathway is incompatible with the sustainable management of resources. I also think it's something that the engineering profession can show leadership in as well, as we are actually talking about changing the nature of a lot of our energy supply technologies, which clearly has a key engineering focus.

We've all got a responsibility to be aware of the current pathway of energy and the urgency to turn that approach around towards a sustainable direction.

Professor Arthur Williamson, University of Canterbury

"Closing Remarks"

Without any apology I'm going to ride a hobbyhorse, since the horse-paddock gate has been opened by Ian with his mention of solar technology.

But before I do that I would like to just emphasise some of the things that Ian said which, in fact, are common to some of the things other people have said in other contexts this afternoon.

Ian talked about time-scales and long-term goals. I think sustainability is very much about time-scales. If you were a physicist trying to set up sustainable nuclear fusion under controlled conditions, a couple of milliseconds would be pretty good; if you are only concerned about your own lifetime, then 50 to 60 years is fair enough. If you are concerned about immortality, about future generations, then you have to think a lot further. And I think the whole concept of sustainability is an expression of our sense of responsibility towards the world we live in and the future inhabitants of that world.

Secondly, people have talked about sustaining the environment and the extent to which that needs to be done. I think one always needs to think of what are the acceptable and unacceptable changes that we make to the environment, and that's been mentioned throughout the day.

A point that appears in Ian's presentation, which isn't evident in a lot of the other approaches, is that many of our concerns are switching to a more global approach, rather than local, national or even international approaches, and I think the energy area is one in which that trend has accelerated in recent years.

Ian and others have talked about economics and, again, the economics of doing or not doing things are very much constrained by the boundaries that you put on your analysis. We heard earlier this afternoon that it is economic to use the ocean as a dumping ground. It may or may not be, depending on whether you see the changes to that part of the environment caused by using it as a dumping ground as being acceptable or not acceptable.

I frequently recall one of Charles Martin's remarks which I think was emphasised by some of the things people said today about what happens to wastes. Charles used to express the principle of conservation of matter in the statement: "you cannot throw it away - there *isn't* any away". I think that leads to recycling - we always recycle our wastes, we are forced to recycle our wastes by the principle of conservation of matter. Whether we recycle them by dumping them in our backyard and living with them, or doing something else with them, is what we are really talking about.

Ian talked about the development of new energy pathways and in particular he talked about solar and solar-derived energy sources. I'd just like to make one comment about the solar character of the New Zealand economy. In the pre-Maui period (I mean by that the second Maui period, the first being when we were fished out of the sea) if we had plotted GDPs against energy consumption for all the countries of the world, we would have found that New Zealand had a much lower energy use per unit of GDP than many of the developed countries. It was about half the average, and my assertion is that that was because New Zealand's economy was about 50% solar. There were two factors, both of which were very sensible activities.

One was hydroelectric generation and the other was nitrogen fixation by white clover. If we converted all the hydroelectric generation to the equivalent fossil-fuel generation and took all the nitrogen that was fixed by white clover and converted that by synthetic chemical processes, we would push the energy : GDP ratio much higher, much closer to the world-wide average level.

So we used to be, in essence, nearly 50% solar driven on those two matters alone. Post-Maui we went into a high-energy mode where we started to use large amounts of fossil fuel for inefficient processes, like generating electricity and making petrol, and we in fact *declined* in efficiency. I think what we ought to be saying is that we should be making our way back to the solar economy.

One point on which I take issue with Ian is in his comment about urgency. He says we have about ten years before we get into trouble and so we don't need to hurry too much. I think that reflects something that was in the energy survey done by the Energy Foundation of New Zealand in which there appeared early in the introduction the brave words: "New Zealand's energy future is secure through until the end of the century". It sounds great - but it's only eight years away. One has to think about how long it takes to develop new technologies and get them into full implementation. I used to talk about the energy hiatus. This is what happens if your planning horizon is x years, and the time it takes you to develop your new technologies is y years and y is greater than x. You will then see the exhaustion of a resource, or the need for a particular technology come over the horizon and it's too late to implement it. I think we are dangerously near to that situation.

Now, let me leave you with a set of assertions on energy in general, and solar energy in particular. One of the things that has to be emphasised is that energy is ubiquitous. It is a part of everything we do and we must look at the energy concerns of everything we do.

The majority of our energy use is from fossil fuel. Carbon combustion is significantly altering the carbon inventories of land, sea and air. That is the point that has become clear - we have fossil carbon, we have oceanic carbon, we have atmospheric carbon as CO_2, and what we are doing at the moment is shifting the carbon inventory from fossil carbon to atmospheric carbon with some also going to the ocean. Nobody is quite sure how big a sink that is, but over the last few years the emphasis in the energy field has shifted from concern for the exhaustion of the terrestrial carbon inventory, if you like, to the overload of the atmosphere. In crude terms, our concern has shifted from how big is the cupboard to how big is the rubbish tin. When the rubbish tin overflows we get unfortunate effects.

The long time constants involved in looking at these effects are of considerable concern. We have already seen one case in the ozone situation where, by the time we had recognised that we had a problem, it was already too late. I think this should be a warning to us with respect to the carbon dioxide situation. People are still arguing about whether the greenhouse effect is really dangerous, and saying "well let's not worry until we've got enough data to confirm that it is a problem". My argument is that the time constants are such that by the time we have determined that we really do have a problem it will be too late. So, therefore, we must act on pessimistic predictions and that means we must act now.

What one does initially, I think, is look to see what technologies one can implement to try and offset the problem, and that could be done with a whole lot of other resource and waste management concerns - you look for what technologies you can use.

I've done a considerable amount of investigation into what chemical engineering can do and, for example, there are a lot of people who say that we can extract the CO_2 from power station flue-gases and store it in various places. I am not very optimistic about those possibilities; about the extent to which existing chemical technology can produce a simple fix. We therefore have to look to substitution and, if you look at the sun, it provides more than enough energy. I think one of the things that changes as we switch from a resource-limited and sink-limited energy situation to a flux-limited energy situation, is that the earth can in essence be seen as a large rotating heat exchanger.

There is a source out there at 6000 K called the sun; the sink is also out there, and it is called space. The source is something the astrophysicists say is going to last for about 5 x 10^9 years, our sink is big, and so our time-scale for sustainability looks good.

If you do the calculations for radiation coming in on half the earth's disk from the sun and being re-radiated into space, you get a steady-state temperature of around 270 K. We need to look at that from a thermodynamic point of view. What we mostly want to do with energy sources is to do work on things; we work on systems to change their state. When we drive motor vehicles, we are extracting work. If you look at this from a thermodynamic point of view we are in essence capable of extracting whatever work we can from radiation at 6000 K being transferred to a sink at about 3 K. It is a good, usable source.

All the science and most of the technology for the use of solar energy already exists. It is often said that the economics look poor, but if one looks at the complete costs of fossil-fuel use, including restitution of the environment, then many of the solar technologies are much more economically competitive.

The scale on which solar energy use needs to be implemented is very small. The flux through the earth is about 10 000 times our current total usage for the whole world. At a 10 percent conversion efficiency, all of the world's needs could be met by three large solar farms. This is one scenario, and I am not suggesting that this is the only way to go, but I am presenting it as an indication of how relatively straightforward the problem is.

We want three large solar plants - one in North Africa or Saudi Arabia, one in the Arizona/New Mexico Desert and one in Australia. Each of these has to be 300 kilometres square - that's about 5% of Saudi Arabia or 1.5% of the North Africa Desert, 1.5% of Australia's desert, and 3% of the Arizona/New Mexico desert. That is easily achievable now; there are already solar thermal power stations operating, with one in California producing 300 MW at 17% overall efficiency. But we don't need to be big, we can also do a lot of other things and wind energy is one of them.

I think the problem is more urgent that Ian suggests; we should be getting on to it now and we should be getting into building demonstration plants of all of the technologies so that we can start gaining the experience that we are going to need to implement them on a large scale in 10 to 15 years time.

DISCUSSION

Jeff Jones : *Ian, I found your suggestion that Regional Councils get into these energy matters very interesting, because I am not aware that there is anything in the Local Government Act or the Resource Management Act which says we can get involved to that extent. Granted we are about to get an application from one of the local power boards to put in a small hydro-electric generating station (and the canoeists are going to be right in there) and we may be able to ask them to demonstrate to us that there is a need to build those stations, but the sort of issues you were talking about were national issues. I think if we start getting into those sort of national energy issues we will have Mr Cooper down on us like a tonne of bricks. I just wondered if you would like to comment?*

Ian McChesney : Well, I don't profess a great insight to knowledge of what might be able to be done under the Resource Management Act and perhaps Dr Tom Fookes would like to make a comment after I've spoken here, but what I would suggest is that Regional Councils under the RMA have a responsibility to look at the efficient use of resources and to look at mitigating the effects, as it affects the environment. Now clearly energy is one of the major forms of pollution, and I believe it is not a great leap of the imagination for a Regional Council to begin to look at the aspects of energy use within its geographic area.

I think that if it doesn't, we've got something of a problem. If the Government has a policy to reduce CO_2 emissions, say by 20%, then clearly one of the major aspects of that would be to get some sort of handle and control on our whole transport system, to try and reduce the CO_2 emissions of transport. Now transport planning is something which comes under Local Authorities, so I think it's a question of trying to look at the opportunities and the possibilities. Because I don't believe that central Government alone is capable of bringing in policies that are going to deal with CO_2 adequately without the active participation and support of Local Government.

Tom Fookes : Natural and physical resources as defined in the Act reads, "... land, water, air, soil, minerals, and energy ..." and so it's one of the obligations of the Regional Council to promote the sustainable management of natural and physical resources in its region and physical resources includes energy.

Malcolm Douglass : *Ian and Arthur, I accept the thrust of all your arguments, and I go back to the halcyon days of the NZERDC and the Ministry of Energy when we used to have annual plans, energy plans. I also recall that several regions got quite heavily into the matter of trying to grapple with energy use within their regions. They were excellent base reports and they could certainly be pulled off the shelves, dusted off and continued. I'd just like to make two points.*

First, I agree with Arthur entirely on the timing. None of the projects that have come to fruition in my working life have come to fruition in less than 15 years, and that is just in the ordinary planning activities that I've been involved in, so I think the urgency is there.

The second point is, there is a tendency to assume that we can dramatically alter the transport or the built environment issue. I have personally done studies, very intense studies, on transportation, moving 60% of the employment of Christchurch all over the place and found that with great effort and moving two-thirds of the employment out of the central area, I was able to make a 7% energy saving. We won't get there through rearranging the urban structure, we will get there by direct conservation and direct affecting of the technology of

transport and of the issues which use energy. I think it would be a vain hope to think that we are going to achieve this through land-use rearrangements.

Ian McChesney : I fully believe that we require an integrated approach to the energy question, and I think high on the top of the list is the question of pricing energy, and pricing energy to start including some of the environmental externalities which are not included now; to start putting proper resource rentals on some of our energy and minerals that are mined and don't have those rentals. I think that we require a cohesive co-ordinated approach. Can I just respond to Arthur's suggestion that I said we don't need to do anything for ten years. I didn't say that, in fact what I did say was that we needed to start with some urgency but that the next ten years does provide us with a stable energy base to actually do the work. We are not in a 1979 oil crisis situation where we have to make a lot of decisions very quickly. I think we have sufficient time over the next ten years to get wind turbines out and get operating experience, so by turn of the century we are in a position to make the right choices about where we go with energy. I have said in this report[1] that we need to start the process of improving efficiency right now, we need to start the initial investment in renewables right now.

[1] *From threat to opportunity : moving to a sustainable energy pathway*. Information Paper No. 35, Centre for Resource Management, Lincoln University

List of Attendees

Dr R.J Aspden	Works Project Services, Wellington
R.G.Bauld	Chief Executive, Northern Disposal Systems Ltd, Auckland
A.N. Bickers	Chief Executive, Tauranga District Council, Tauranga
J.P. Blakeley	Centre for Advanced Engineering, University of Canterbury
N. Borrie	AEI, Lincoln University, Canterbury
J.W. Bradley	Royds Garden Ltd, Dunedin
M. Douglass	Porirua City Council, Porirua
J.N. Duder	Tonkin and Taylor Ltd, Auckland
R.C.M. Dunn	Department of Civil Engineering, University of Auckland
Assoc. Prof. W.B. Earl	Department of Chemical and Process Engineering, University of Canterbury
B. Earnshaw	Waimakiriri District Council, Rangiora
Prof. D.G. Elms	Department of Civil Engineering, University of Canterbury
Dr T. Fookes	Ministry for the Environment, Wellington
Dr M. Freeman	Canterbury Regional Council, Christchurch
M. Garland	Queenstown-Lakes District Council, Queenstown
D.R. Gordon	Department of Civil Engineering, University of Canterbury
M.J. Healy	Hawkes Bay Regional Council, Napier
R. Higgins	Canterbury Area Health Board, Christchurch
D. Jackson	Ministry for the Environment, Christchurch
P. Jenkins	Martinborough
J.A. Jones	Chief Executive, Bay of Plenty Regional Council, Whakatane
M.J. Kennedy	Grey District Council, Greymouth
S. Kinnear	Conultant Planner and Registered Surveyor, Upper Hutt
B.H. Knowles	Royds Garden Ltd, Palmerston North
J.L. Lumsden	Centre for Advanced Engineering, University of Canterbury
I. McChesney	Consultant on Sustainable Resource Use, Christchurch
D. McFadden	Woodward-Clyde N.Z. Ltd, Christchurch
J. McFarlane	Royds Garden Ltd, Nelson
B. McKenzie	Waimakariri District Council, Rangiora
M. McTigue	Waimakariri District Council, Rangiora
F. Norton	Royds Garden Ltd, Christchurch
K. O'Boyle	Selwyn District Council, Leeston
Dr D.J. Painter	Department of Natural Resources Engineering, Lincoln University, Canterbury
Dr N.J. Peet	Department of Chemical and Process Engineering, University of Canterbury
R. Potts	AEI, Lincoln University, Canterbury
Dr J.K. Raine	Department of Mechanical Engineering, University of Canterbury
R Reid	Canterbury Regional Council, Christchurch
Dr J. Roper-Lindsay	Consultant, Boffa Miskell Partners Ltd, Christchurch
P. Sheldon	Selwyn District Council, Leeston
M. Sorrell	Royds Garden Ltd, Christchurch
Prof. G. Sparks	Visitor, Department of Civil Engineering, University of Canterbury (University of Saskatchewan, Canada)
Dr R. Spigel	Department of Civil Engineering, University of Canterbury
N. Taylor	Royds Garden Ltd, Christchurch
B. Thompson	Waimakariri District Council, Rangiora
P.D. Tweed	Grey District Council, Greymouth
J. van Beek	Serco Group NZ Ltd, Wellington
H. Versteegh	Canterbury Regional Council, Christchurch
Prof. A.G. Williamson	Department of Chemical and Process Engineering, University of Canterbury
C. Willmot	Connell Wagner Rankine and Hill Ltd, Wellington
J. Youngson	Banks Peninsula District Council, Lyttelton